# Sampling and Analysis Plan

# Grey Eagle Tailings Removal Assessment

**TDD No.: TO-02 09-11-08-0001**
**Job No.: 002693.2151.01RA**

**September 2011**

**Prepared for:**

**U.S. ENVIRONMENTAL PROTECTION AGENCY**
**Region 9**

**Prepared by:**

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**Superfund Technical Assessment and Response Team**

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# List of Abbreviations and Acronyms

| | |
|---|---|
| CFR | Code of Federal Regulations |
| COPC | contaminant of potential concern |
| DQI | data quality indicator |
| DQO | data quality objective |
| E & E | Ecology and Environment, Inc. |
| EPA | (United States) Environmental Protection Agency |
| FOSC | Federal On-Scene Coordinator |
| GPS | Global Positioning System |
| IDW | investigation-derived waste |
| LCS | laboratory control sample |
| MS/MSD | matrix spike/matrix spike duplicate |
| PE | Performance Evaluation |
| PM | Project Manager |
| PPE | personal protective equipment |
| QA | quality assurance |
| QC | quality control |
| SAP | Sampling and Analysis Plan |
| SOP | standard operating procedure |
| START | Superfund Technical Assessment and Response Team |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |

# 1 Introduction

The United States Environmental Protection Agency (EPA) directed Ecology and Environment, Inc.'s (E & E) Superfund Technical Assessment and Response Team (START) to support an EPA funded surface water and soil investigation to further determine the need for potential Removal Program actions at the Grey Eagle Mine Tailings Repository near Happy Camp, Siskiyou County, California. To support the EPA's environmental data collection activities, START has identified project data quality objectives and developed this Sampling and Analysis Plan (SAP).

The Grey Eagle site (the Site) is a tailings repository located adjacent to Indian Creek approximately 5 miles north of the town of Happy Camp, California. The tailings pile appears to have been generated during the 1941 to 1945 period of mining, when millings were sent by flume down to the site for cyanide extraction. The tailings have since been capped and surface drains have been installed above the cap to create the current repository.

This SAP describes the project and data use objectives, data collection rationale, quality assurance goals, and requirements for sampling and analysis activities. It also defines the sampling and data collection methods that will be used for this project. This SAP is intended to accurately reflect the planned data-gathering activities for this support activity; however, site conditions, budget, and additional EPA direction may warrant modifications. All significant changes will be documented in site records.

The specific field sampling and chemical analysis information in this SAP was prepared in accordance with the following EPA documents: EPA *Requirements for Quality Assurance Project Plans* (EPA QA/R 5, March 2001, EPA/240/B 01/003); *Guidance for the Data Quality Objectives Process* (EPA QA/G 4, February 2006, EPA/240/R 02/009); *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G 5S, December 2002, EPA/240/R 02/005); and *Uniform Federal Policy for Implementing Environmental Quality System* (EPA/505/F-03/001, March 2005).

## 1.1 Project Organization

The following is a list of project personnel and their responsibilities:

**EPA Federal On-Scene Coordinator (FOSC)** – The EPA FOSC is Christopher Weden. Mr. Weden is the primary decision-maker and will direct the project, specify tasks, and ensure that the project proceeds on schedule and is within budget. Additional duties include coordinating communication with the START Project Manager, EPA Quality Assurance (QA) Office, and EPA Region 9 Laboratory, if applicable.

**START Project Manager (PM)** – Mr. Derek Ormerod is the START PM. The START PM manages the project's data collection efforts and is responsible for writing and implementing the SAP, coordinating project tasks and field sampling, managing field data, and completing all preliminary and final reporting. Mr. Ormerod is also the primary SAP author and responsible for development of this SAP. Specifically, Mr. Ormerod is responsible for the documentation of project objectives and for preparation of the draft and final SAP document.

**Principal Data Users** – Data generated during the implementation of this SAP will be utilized by the FOSC to make decisions regarding potential future actions at the site.

**START QA Coordinator** – Mr. Howard Edwards is the START QA Coordinator. Mr. Edwards will coordinate with the EPA's QA Office as needed.

**Sample Analysis and Laboratory Support** – The EPA Region 9 Laboratory will be utilized for analysis of contaminants of potential concern (COPCs) and for additional water quality analyses. If necessary, a START subcontracted laboratory may be used to provide adequate reporting limits (see Section 3.3).

## 1.2 Distribution List

Copies of the final SAP will be distributed to the following persons and organizations:

- Christopher Weden, EPA, Region 9
- E & E START Field Team
- E & E START project files

## 1.3 Statement of the Specific Problem

The main concerns at the site are the potential for heavy metal concentrations and the acidic conditions caused by the oxidation of the sulfide phases present in and around the tailings to be leaching from the tailings repository and entering Indian Creek. The COPCs for this assessment include copper, arsenic, and acidic conditions.

Environmental data from sampling and analysis is required to adequately determine the presence and concentrations of the COPCs migrating from the site. Due to the persistent nature of metals in the environment and their potential toxicity to human health and the environment, a removal assessment will be conducted both to evaluate the concentrations of COPCs and to determine the spatial extent of COPCs that exceed action levels.

# 2 Background

## 2.1 Site Location

The Grey Eagle Mine is located approximately 5 miles north of the town of Happy Camp, Siskiyou County, California. The tailings repository is located adjacent to Indian Creek (see Figure 1). The approximate location of the site is 41° 51' 27" north latitude, 123° 23' 54" west longitude. The site is located off of highway of Indian Creek Road on private land.

## 2.2 Site Description

The tailings repository is approximately 400 feet long and 200 feet wide, with an approximate area of 80,000 square feet. The runoff from the site drains into Indian Creek, which is a tributary to the Klamath River. The site is primarily an open meadow area underlain by the capped tailings and debris and concrete pads associated with a former mill on site. Additional background sampling will be conducted on several tributaries and on Indian Creek. Water levels, widths, and depths of these water bodies vary substantially depending on weather conditions.

## 2.3 Site History

According to EPA files, the mine is currently inactive and owned by the Siskon Gold Corporation of Grass Valley, California. Exploration and mining began in 1895; sulfide copper ores were mined sporadically through the early half of the twentieth century under several operators. From 1941 to 1945, the Grey Eagle Mining Company (a subsidiary of Newmont Mining Company) operated a deep-tunnel copper mine. The ore was milled on site, and the tailings were pumped to the tailings site at the mouth of Luther Gulch, along Indian Creek. Along with copper, byproducts of gold and silver were also extracted from the millings. There is no evidence of activity at the mine from 1945 until 1981; the mine was owned by the Standard Slag Company of Reno, Nevada, during this time. The Noranda Mining Company reopened the Grey Eagle Mine, extracting gold and silver from 1981 through 1986.

The tailings pile appears to have been generated during the 1941 to 1945 period of mining, when millings were sent by flume down to the site for cyanide extraction. In about 1952, a depression of approximately 450,000 square feet and 15 feet deep was constructed in the tailings pile and utilized as a log pond by a saw mill which was operated on the site by the Willamette Lumber Company (Willamette) from 1945 to 1965. Croman Corporation owned the property from 1975 to 1990; Siskon Gold Co. owned the property from 1990 to 1996. There is no report of tailings having been dumped on the site during the mining activity in the 1980s. The property is currently privately owned by B. McCoy, the former site caretaker.

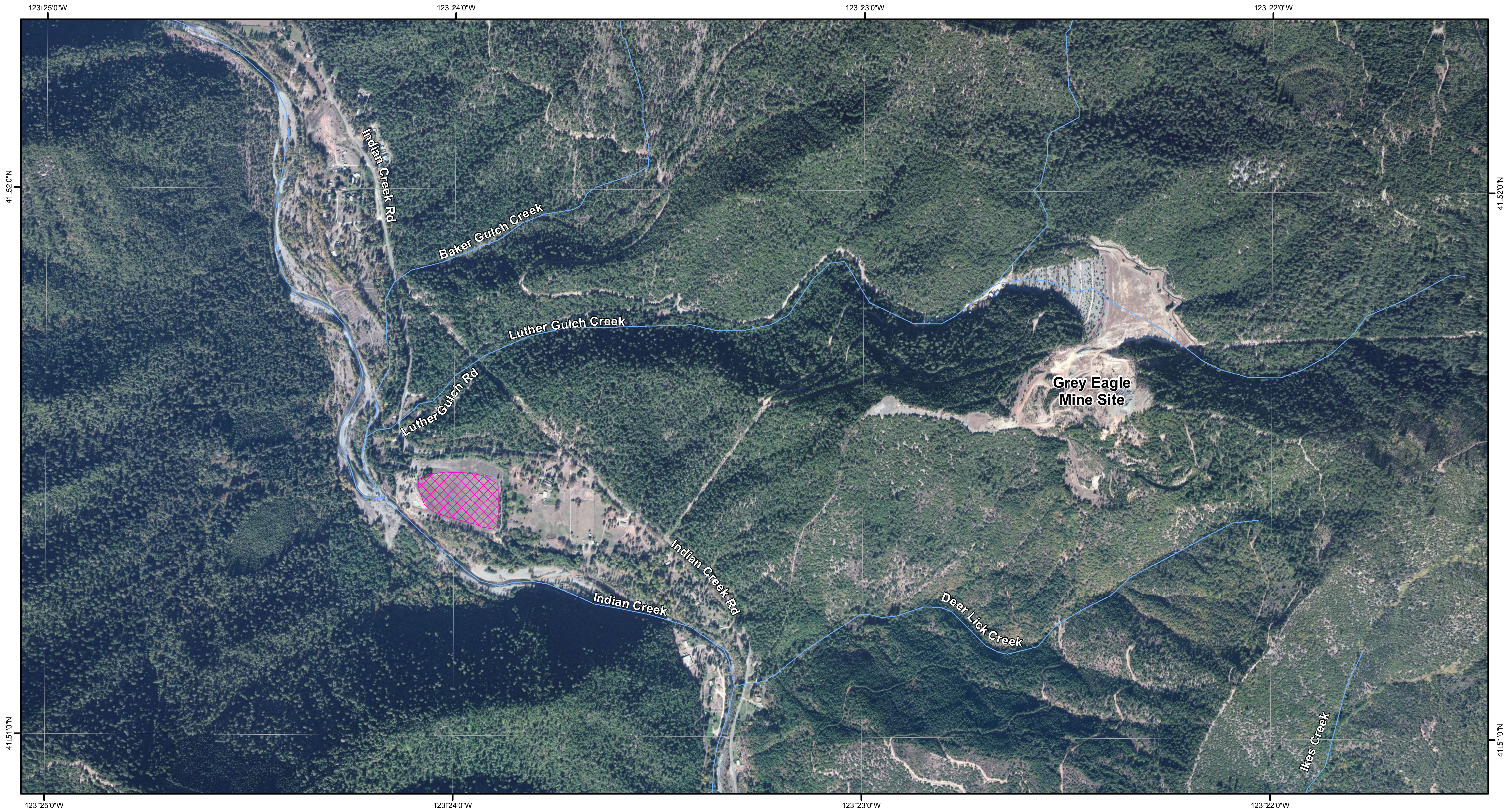
Data from a 1996 assessment indicate that there is no residual cyanide from the extraction process which took place from 1941 to 1945; the main concerns at the tailings site are the heavy metal concentrations in the sulfide deposits and the acidic conditions caused by the oxidation of the sulfide phases present. In 1998, under the direction of the EPA, START performed an assessment that demonstrated groundwater is present at depth in the tailings pile and that only the uppermost surface of the tailings was oxidized.

A remedial action was completed in 1998 that consolidated the tailings in the former log pond and capped the material with an impervious plastic liner. Native soil and vegetation was placed on top of the liner to limit the infiltration of atmospheric oxygen into the tailings pile. Tailings were removed from a small parcel of land owned by the United States Department of Agriculture (USDA) Forest Service and consolidated in the log pond. The southern berm of the log pond was removed and re-graded to a slope of 2 percent. The surface of the capped areas was graded to 1.5 percent and a surface drain system was constructed to facilitate stormwater drainage from the surface of the cap. Finally, riprap was installed at the base of the tailings pile adjacent to a side-channel of Indian Creek to protect the tailings from erosion. All of these items appeared to be intact as of a site visit in August 2011.

## 2.4 Geology, Hydrology, and Hydrogeology

Based on United States Geological Survey (USGS) WebSoil Survey, the soil characteristics beneath the tailings at the site are expected to consist of approximately 60 percent sand with equal remaining parts of clay and silt. The geology is expected to consist of alluvial deposits, as the site sits in one of the broader areas of the Indian Creek floodplain with bedrock in the adjacent ridge feature.

Groundwater flow in the region is likely to flow towards the site and discharge into the Indian River or Klamath River, in a general southwesterly direction. A relatively low ridge runs adjacent to the site on the opposite side of Indian Creek Road. The Indian Creek valley is located between many mountains: Slater Butte is north, Titus Peak is south, Williams Point is east Williams Point, and Baldy Mountain is west.





Streams and Creeks

Tailings Repository

**Source:** StreamNet (http://www.streamnet.org), May 2010. ESRI, 2009.

N W E S

Map Projection: NAD 1983 UTM Zone 10N Meter
Map Scale: 1: 12,000

0 100 200 400 600 800
Meters
1 centimeter = 120 meters

**Figure 1**

**Grey Eagle Mine**
**Site Location**

**Siskiyou County, California**

Ecology & Environment, Inc. GIS Department Project: R:\3 START 3\Grey Eagle Mine\GIS\Maps\MXDs\figure_1_regional_area.mxd Date: 9/8/2011)

## 2.5 Site Drainage

The site generally drains towards Indian Creek and its associated side channels. There are no known sewer system drainages. The surface of the capped areas was graded to 1.5 percent and a surface drain system was constructed to facilitate stormwater drainage from the surface of the cap. Riprap was installed at the base of the tailings pile adjacent to a side-channel of Indian Creek to protect the tailings from erosion.

## 2.6 Previous Investigations and Regulatory Involvement

At the direction of EPA Region 9, START performed an assessment in the mid 1990s that demonstrated groundwater is present at depth in the tailings pile and that only the uppermost surface of the tailings was oxidized. A remedial action was then completed in 1998 that consolidated the tailings in the former log pond and capped the material with an impervious plastic liner.

# 3 Project Objectives

## 3.1 Data Use Objectives

The data generated by implementing this SAP will be used to evaluate potential future actions at the site and determine if the site negatively impacts surface water conditions in Indian Creek. The sampling results and field observations will also be reviewed so potential sources of COPCs and the extent of contamination at concentration that exceed the action levels can be identified.

## 3.2 Project Task/Sampling Objectives

The EPA directed START to prepare this SAP to support environmental data collection activities necessary to determine potential future actions at the site.

Surface soil, seep, and surface water sampling followed by laboratory analysis will be implemented to accomplish the project objectives. Sampling objectives include the following:

- Document the concentrations of copper, arsenic, sulfate, chloride, pH, and water quality parameters in the observed seeps that discharge into Indian Creek and determine where these concentrations exceed site action levels.

- Document the concentrations of copper, arsenic, sulfate, chloride, pH and water quality parameters in surface water in the vicinity of the site and determine where these concentrations exceed site action levels.

- Document the concentrations of copper, arsenic sulfate, chloride, and pH levels in surface soils at the site and determine where these concentrations exceed site action levels.

## 3.3 Action Levels

Project-specific action levels are based on the lowest applicable values between regional standards and EPA standard guidance. For surface water, the standards are a combination of Water Quality Control Plan for the North Coast Region Standards for the Mid Klamath Basin, in the category of "Other" surface water features (North Coast Regional Water Quality Board 2011) and the EPA Water Quality National Recommended Water Quality Standards (EPA 2009; Table 3-1).

Copper values presented in Table 3-1 are based on a hardness value of 100 and will be calculated in the future based on actual hardness values. Note that values presented in Table 3-1 refer to the regional guidance.

Soil action levels are a combination of California EPA Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil (California Environmental Protection Agency 2005) and the EPA National Database of Screening Levels for the remaining constituents (EPA 2011; Table 3-2). Note that values presented in Table 3-2 refer to the regional guidance.

Reporting limits from the recommended laboratory analysis provide sufficiently low results to be able to compare data results with the action levels with a couple of exceptions: cadmium, lead, selenium and silver for the water samples and arsenic for the soil samples. To solve this concern, the water samples will initially be analyzed using EPA Method 200.7 (higher detection limits) and if non-detects are recorded for the four metals listed above, a second analysis using EPA Method 200.8 (lower detection limits) will be conducted. This will provide sufficiently low values to be able to compare the results with action levels. None of the metals with reporting limit concerns for water are COPCs but are water quality indicators; however, sample results from other studies have shown that they are present in Indian Creek at levels that may be below the detection limits of EPA Method 200.7, but above the action levels. Arsenic, however, is a COPC for soil. The plan to provide sufficient reporting limits is to initially analyze the soil samples by EPA Method 6010B and if arsenic is non-detect, then an additional laboratory will be contracted with to analyze the soil samples using an alternate method that provides reporting limits at or below the action levels. The holding time for metals analysis in soils is 6 months, so there should be sufficient time to make the necessary arrangements.

## 3.4 Data Quality Objectives

The Data Quality Objectives (DQO) Process for the Grey Eagle Tailings Removal Assessment is presented in Appendix A.

## 3.5 Schedule of Sampling Activities

The field sampling activities will be scheduled upon approval of the SAP by the EPA. Field sampling will take approximately 1.5 days, depending on weather conditions, sampling methods, and site access, and is scheduled to occur on three separate occasions.

## 3.6 Special Training Requirements/Certifications

Data validation requires specialized training and experience. A START chemist will likely complete the data validation.

Field sampling personnel will be trained and have experience with surface soil, seep water, and surface water sampling at hazardous waste sites while wearing respiratory protective equipment. One field sampler should be trained and familiar with Global Positioning System (GPS) data collection. All sampling personnel must have appropriate training that complies with 29 Code of Federal Regulations (CFR) 1910.120. The site-specific health and safety plan for this project is appended to this plan (see Appendix B).

**Table 3-1 Surface Water and Seeps Data Quality Indicator Goals, Grey Eagle Tailings Removal Assessment Siskiyou County, California**

| Chemical of Potential Concern | EPA National Water Quality Standards or North Coast Basin Plan[1] (mg/L) | Analytical Method | Laboratory Reporting Limits (mg/L) | Accuracy (% Recovery for MS/ MSD) | Precision (RPD from MS/MSD and Duplicates) | Percent Complete |
|---|---|---|---|---|---|---|
| **Metals** | | | | | | |
| Arsenic | 0.05* | 200.7 | 0.02 | 75 – 135 | <20 | > 80% |
| Copper | 0.013[2] | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |
| **Anions** | | | | | | |
| Chloride | 230 | 300.0 | 0.2 | 75 – 135 | <20 | > 80% |
| Sulfate | NA | 300.0 | 0.2 | 75 – 135 | <20 | > 80% |
| **Acidity** | | | | | | |
| pH | 8.5 – 7.0* | 9040 | 1-14 | 75 – 135 | < 20 | > 80% |
| **Water Quality Parameters** | | | | | | |
| Hardness | 60* | 2340B | 10 | 75 – 135 | < 20 | > 80% |
| Total Dissolved Solids | 250* | 2540C | 5 | 75 – 135 | < 20 | > 80% |
| **Water Quality Metals** | | | | | | |
| Aluminum | 1.0* | 200.7 | 0.1 | 75 – 135 | <20 | > 80% |
| Antimony | NA | 200.7 | 0.02 | 75 – 135 | <20 | > 80% |
| Barium | 1.0* | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |
| Beryllium | NA | 200.7 | 0.001 | 75 – 135 | <20 | > 80% |
| Boron | 0.1* | 200.7 | 0.1 | 75 – 135 | <20 | > 80% |
| Cadmium | 0.00025 (0.01*) | 200.8 | 0.001 | 75 – 135 | <20 | > 80% |
| Calcium | NA | 200.7 | 0.1 | 75 – 135 | <20 | > 80% |
| Chromium | 0.05* | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |
| Cobalt | NA | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |
| Lead | 0.0025 | 200.8 | 0.002 | 75 – 135 | <20 | > 80% |
| Manganese | NA | 200.7 | 0.005 | 75 – 135 | <20 | > 80% |
| Mercury | 0.00077 (0.002*) | 245.1 | 0.0002 | 75 – 135 | <20 | > 80% |
| Nickel | 0.052 | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |
| Selenium | 0.005 | 200.8 | 0.001 | 75 – 135 | <20 | > 80% |
| Silver | 0.0032[3] | 200.8 | 0.0005 | 75 – 135 | <20 | > 80% |
| Sodium | NA | 200.7 | .02 | 75 – 135 | <20 | > 80% |

**Table 3-1 Surface Water and Seeps Data Quality Indicator Goals, Grey Eagle Tailings Removal Assessment Siskiyou County, California**

| Chemical of Potential Concern | EPA National Water Quality Standards or North Coast Basin Plan[1] (mg/L) | Analytical Method | Laboratory Reporting Limits (mg/L) | Accuracy (% Recovery for MS/ MSD) | Precision (RPD from MS/MSD and Duplicates) | Percent Complete |
|---|---|---|---|---|---|---|
| Thallium | NA | 200.7 | 0.002 | 75 – 135 | <20 | > 80% |
| Vanadium | NA | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |
| Zinc | 0.120 | 200.7 | 0.01 | 75 – 135 | <20 | > 80% |

Key:
ERM = Effects Range Median (marine sediment)
mg/L = milligrams per Liter
MS/MSD = Matrix Spike/Matrix Spike Duplicate
NA = Not available
RPD = Relative Percent Difference

[1] U.S. EPA National Recommended Water Quality Standards values are Chronic Contaminant Concentrations for Freshwater. Values noted with an asterisk (*) come from the North Coast Basin Plan Standards using the Mid Klamath River Hydrologic Area for "Other Streams". When presented alone these values are lower than the corresponding U.S. EPA standards. When presented in parentheses, these values are greater than the corresponding U.S. EPA standards.
[2] The water quality value for Copper is based on 100 mg/L as CaCO3 and will be modified to actual values on a sample by sample case based on actual hardness results.
[3] The value for Silver is based on Acute Contaminant Concentrations, as no Chronic value is provided.

**Table 3-2 Soil Data Quality Indicator Goals,**
**Grey Eagle Tailings Removal Assessment**
**Siskiyou County, California**

| Chemical of Potential Concern | EPA National Database of Screening levels or CalEPA Human-Exposure Based Screening Numbers[1] (mg/kg) | Analytical Method | Laboratory Reporting Limits (mg/kg) | Accuracy (% Recovery for MS/ MSD) | Precision (RPD from MS/MSD and Duplicates) | Percent Complete |
|---|---|---|---|---|---|---|
| **Metals** | | | | | | |
| Arsenic | 0.07* | 6010B | 2.0[2] | 75 – 135 | <20 | > 80% |
| Copper | 3,000* | 6010B | 4.0 | 75 – 135 | <20 | > 80% |
| **Anions** | | | | | | |
| Chloride | NA | 300.0 | | 75 – 135 | <20 | > 80% |
| Sulfate | NA | 300.0 | | 75 – 135 | <20 | > 80% |
| **Acidity** | | | | | | |
| pH | NA | 9040 | | 75 – 135 | < 20 | > 80% |
| **Soil Quality Metals** | | | | | | |
| Aluminum | 77,400 | 6010B | 100 | 75 – 135 | <20 | > 80% |
| Antimony | 3.0* | 6010B | 2.0 | 75 – 135 | <20 | > 80% |
| Barium | 5200* | 6010B | 5.0 | 75 – 135 | <20 | > 80% |
| Beryllium | 150* | 6010B | 0.10 | 75 – 135 | <20 | > 80% |
| Boron | 15,600 | 6010B | 10 | 75 – 135 | <20 | > 80% |
| Cadmium | 1.7* | 6010B | 0.50 | 75 – 135 | <20 | > 80% |
| Calcium | NA | 6010B | 100 | 75 – 135 | <20 | > 80% |
| Chromium | 100,000* | 6010B | 1.0 | 75 – 135 | <20 | > 80% |
| Cobalt | 2.34 | 6010B | 2.0 | 75 – 135 | <20 | > 80% |
| Lead | 150* | 6010B | 3.0 | 75 – 135 | <20 | > 80% |
| Manganese | NA | 6010B | 5.0 | 75 – 135 | <20 | > 80% |
| Mercury | 1.02 (1.8*) | 7471 | 0.15 | 75 – 135 | <20 | > 80% |
| Molybdenum | 380* | 6010B | 5.0 | 75 – 135 | <20 | > 80% |
| Nickel | 1550 (1600*) | 6010B | 5.0 | 75 – 135 | <20 | > 80% |
| Selenium | 380* | 6010B | 2.0 | 75 – 135 | <20 | > 80% |
| Silver | 380* | 6010B | 1.0 | 75 – 135 | <20 | > 80% |
| Sodium | NA | 6010B | 50 | 75 – 135 | <20 | > 80% |

## Table 3-2 Soil Data Quality Indicator Goals, Grey Eagle Tailings Removal Assessment Siskiyou County, California

| Chemical of Potential Concern | EPA National Database of Screening levels or CalEPA Human-Exposure Based Screening Numbers[1] (mg/kg) | Analytical Method | Laboratory Reporting Limits (mg/kg) | Accuracy (% Recovery for MS/ MSD) | Precision (RPD from MS/MSD and Duplicates) | Percent Complete |
|---|---|---|---|---|---|---|
| Thallium | 5.0* | 6010B | 5.0 | 75 – 135 | <20 | > 80% |
| Vanadium | 394 (530*) | 6010B | 2.0 | 75 – 135 | <20 | > 80% |
| Zinc | 23000* | 6010B | 8.0 | 75 – 135 | <20 | > 80% |

Key:

mg/kg = milligrams per kilogram
MS/MSD = Matrix Spike/Matrix Spike Duplicate
NA = Not available
RPD = Relative Percent Difference

[1] U.S. EPA National Database of Screening Levels are Chronic levels based on Residential Values. Values noted with an asterisk (*) come from the California EPA Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. When presented alone these values are lower than the corresponding U.S. EPA standards. When presented in parentheses, these values are greater than the corresponding U.S. EPA standards.

[2] If soil samples are returned Non-Detect from the EPA laboratory, E & E will contract with an outside laboratory to obtain the necessary detection limits for the arsenic soil.

# 4 Sampling Rationale and Design

START performed a recent site visit with interested parties and consulted with the EPA FOSC to determine the specific sampling design. Based on this information, the current investigation of the site will focus on the discharges from the tailings repository and potential impacts to adjacent Indian Creek. The investigation area will also be extended upstream on Indian Creek above the confluence with Baker Gulch and downstream below the confluence with Deer Lick Creek to adequately capture background conditions and determine the influence of nearby tributaries that may have upstream water quality impacts from the mine site on Indian Creek. The three tributaries are Baker Gulch, Luther Gulch, and Deer Lick Creek. In addition, two side channels of Indian Creek will be investigated to determine potential impacts from the tailings repository and potential upstream impacts: one at the toe of the slope that contains the tailing repository and the other upstream adjacent to where Baker and Luther Gulch enter Indian Creek.

Sampling will occur during three different hydrologic regimes to provide information regarding the seasonal variation of potential COPCs discharging from the previously capped tailings piles and to determine seasonal variations in surface water, if they exist. The COPC concentrations may vary seasonally depending on stormwater flow, ground and surface water variations and other natural occurrences. The timeframe of the planned sampling investigation is intended to capture the following conditions:

- Low stream flow/low groundwater conditions (September 2011);
- High stream flow/low groundwater conditions (October/November 2011); and
- Moderate stream flow/high groundwater conditions (Spring 2012).

## 4.1 Sampling Locations

Samples from the multiple areas will be collected to meet the project objectives. The primary focus of this investigation is to characterize the impacts to Indian Creek from water observed to be discharging from the capped tailings at the repository. Anticipated sample locations are shown on Figure 2; however, exact sample locations are dependent on where water is observed discharging during the sampling events and based on site conditions. As such, sample locations are subject to change and be modified at the discretion of the field sampling team, in conjunction with the EPA FOSC, who will be on site during the sampling effort.

Three general areas will be sampled to determine potential impacts of the tailings repository:

- Observed seeps from the tailings repository;
- Adjacent surface water, including upstream, downstream, background, and tributaries; and
- Soil adjacent to the seeps.

### 4.1.1 Seep and Surface Water Samples

Based on an August 2011 site visit, three seep-related samples locations were identified. These locations are:

- Two location on the upstream portion of the tailings that discharges directly to Indian Creek;
- One location at the ponded water at the downstream edge of the capped tailings.

Three additional samples will be reserved for the time of the field investigation and will be collected from either additional seeps or at additional ponded areas that exhibit oxide staining, with a preference given to seeps and a second preference given to locations with observed staining. Sample locations are shown on Figure 2.

Surface water samples will be collected from Indian Creek and its tributaries to characterize surface water conditions. One surface water sample will be collected at each of the following locations:

- Indian Creek: upstream of confluence with Baker and Luther Gulch;
- Indian Creek side-channel in vicinity of Baker/Luther Gulch confluence;
- Indian Creek: downstream of Baker/Luther Gulch confluence and upstream of tailings repository;
- Indian Creek: downstream of initial two seeps that discharge directly to Indian Creek;
- Indian Creek: downstream of side channel that collects discharge at the toe of the repository;

- Indian Creek: downstream of the confluence with Deer Lick Creek;
- Baker Gulch: upstream of the confluence with Luther Gulch;
- Luther Gulch: upstream of the confluence with Baker Gulch; and
- Deer Lick Creek: upstream of the confluence with Indian Creek.

Sample locations are shown on Figure 2.

Stream samples will be collected in well-mixed areas and are intended to be representative of overall water quality at the specified reach. Samples will not be targeted as worst-case scenarios, but will focus on representative conditions. If possible, samples will be collected in the central portion of the channel at approximately 1 foot below the water surface. If necessary to wade in the water, samples will be collected upstream of the sampler and efforts will be made to minimize sediment in the samples.

All surface water and seep samples will be collected with a battery-operated peristaltic pump and dedicated tubing. Efforts will be made, particularly in the ponded water and seep samples, to collect only surface water and not disturb the sediment.

Field monitors will be used to collect additional information regarding both surface water and seeps. At a minimum, the following parameters will be monitored and recorded at each water sampling location:

- pH;
- Conductivity;
- Temperature;
- Oxidation reduction potential; and
- Dissolved oxygen.

### 4.1.2 Soil Samples

Soil samples will be collected at areas of observed staining along the toe of the tailings repository. The exact areas will be determined in the field based on site conditions and observations, but a maximum of eight total soil samples will be collected in this area. These samples will include both a surface soil sample and a sample at depth. The depth of the bottom sample will be determined in the field based on visual observations of staining and will attempt to determine a maximum depth of observed contamination, if this is relevant. Samples will be collected with either a shovel or hand auger. These soil sample locations may extend further downstream along the Indian Creek side channel beyond the tailings repository, depending on observations.

At least two additional soil samples will be collected from the soil that contains precipitated salts observed in association with the two seeps at the upstream portion of the tailings reservoir. These will both be surface samples only and are intended to better characterize the discharge from the seeps.

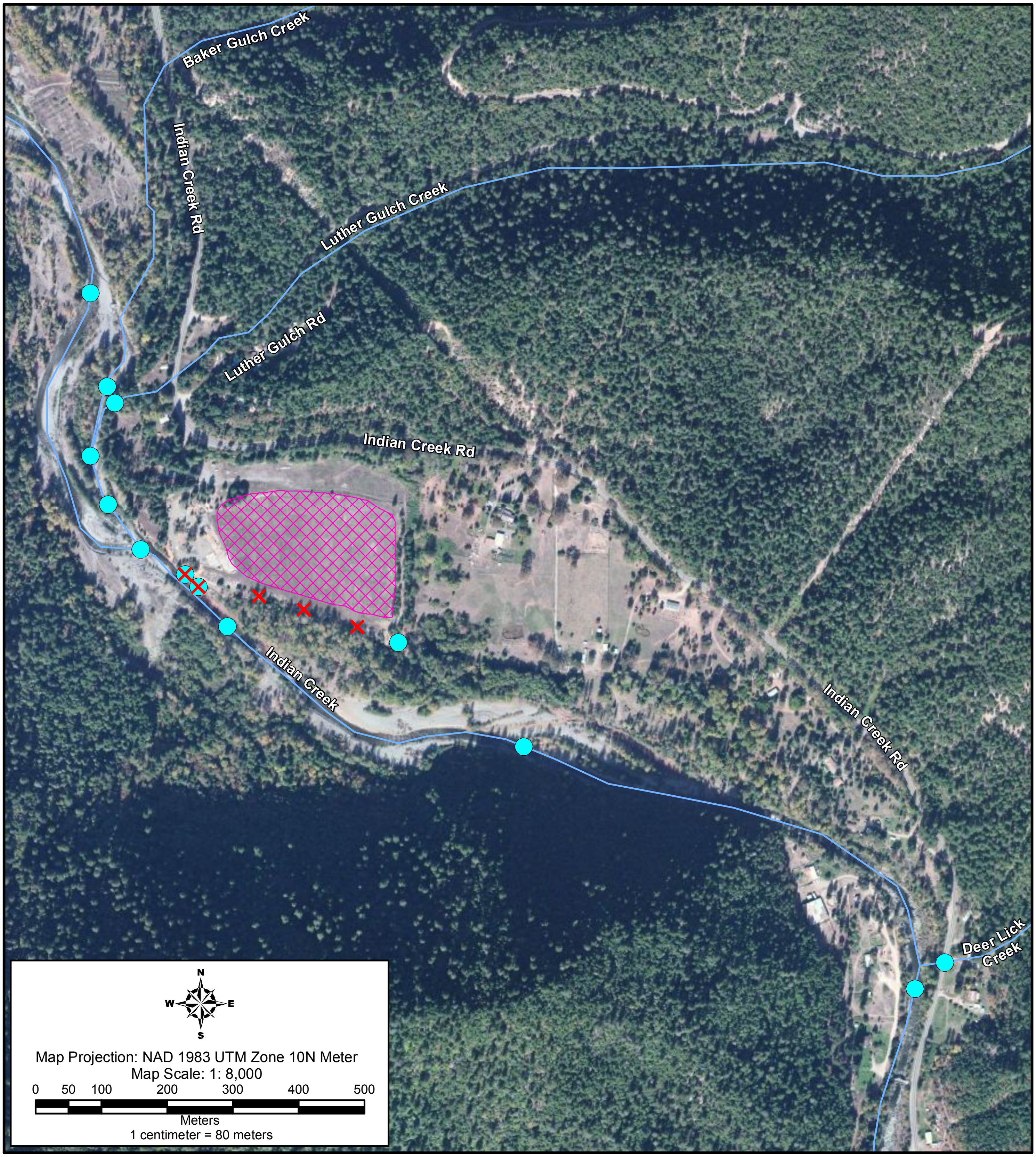
GPS data will be collected at all sampling locations to provide documentation of locations and to allow the same locations to be sampled at subsequent sampling events. Table 5-1 summarizes the samples to be collected. Additional samples may be identified and investigated as directed by the FOSC.

## 4.2 Sample Depths

Surface water samples, including seeps and ponded areas, will be collected at mid-depth in the water column, unless collected from the bank because the water is too deep or fast to enter, in which case water will be collected 1 foot below the water surface. Soil samples will be collected on the surface and at a depth to be determined in the field. The soil sample at depth is intended to determine potential impacts of deposition, so soil samples at depth will be collected at a depth of recently deposited material along the toe of the tailings repository.

## 4.3 Analytes of Concern

The anticipated primary analytes of concern are pH, copper, and arsenic.




Proposed Soil Sample Location

Proposed Water Sample Location

Tailings Repository

**Note:** Sample locations adjacent to the tailings repository are approximate and may be adjusted in the field based on site conditions.

**Source:** StreamNet (http://www.streamnet.org), May 2010. ESRI, 2009.

**Figure 2**

# Grey Eagle Mine

## Proposed Sample Locations

## Siskiyou County, California

Ecology & Environment, Inc. GIS Department Project: R:\3 START 3\Grey Eagle Mine\GIS\Maps\MXDs\figure_2_tailings_repository.mxd Date: 9/8/2011)

# 5 Analytical Testing

It is anticipated that up to 15 surface water and seep water samples and eight soil samples, plus two matrix spike/matrix spike duplicate (MS/MSD) and three field duplicate samples will be collected and sent to an analytical laboratory for testing. The specific laboratory analytical analyses are described below.

## 5.1 Laboratory Analysis

All surface water samples collected will be analyzed for COPCs by the following methods:

- Total metals by EPA Method 200.7 or 200.8 and 245.1;
- Dissolved metals by EPA Method 200.7 or 200.8 and 245.1;
- Chloride and sulfate by EPA Method 300.0;
- Hardness by EPA Method 2340B;
- pH by EPA Method 9040; and
- Total dissolved solids by EPA Method 2540C.

Samples collected for dissolved metals will be field filtered using a 0.45-micron filter.

Sample containers, preservatives, holding times, and estimated number of field samples for surface water and seep water samples are summarized in Table 5-1.

All soil samples collected will be analyzed for COPCs by the following methods:

- Total metals by EPA Method 6010B/7471;
- Chloride and sulfate by EPA Method 300.0; and
- pH by EPA Method 9040.

Sample containers, preservatives, holding times, and estimated number of field samples for soil samples are summarized in Table 5-2.

The EPA Region 9 laboratory will perform the analytical services. A START subcontracted lab may be used for additional soil analysis if arsenic reporting limits are not sufficient to provide comparison values for the action levels.

To provide analytical quality control (QC) for the analytical program, the following measures will be utilized:

- Additional sample volume will be collected for at least 5 percent of samples per each matrix type (soil and water), to be utilized for MS/MSD analysis.

- Split duplicate samples will be collected from 10 percent of the sampling locations that are submitted for soil or water analysis. A duplicate split sample is a 50/50 split of a multi-incremental sample after collection. These will be provided a different sample name and tracked in the field documentation.

- For non-dedicated equipment, a rinsate blank will be collected at a rate of one per day to evaluate decontamination procedures at the site. The rinsate blank will be collected by pouring deionized water over the decontaminated sample collection device (e.g., hand auger or shovel) and capturing the water in the specified sample container.

The field QA/QC sample requirements are summarized in Table 5-1 and 5-2.

**Table 5-1 Sampling and Analysis Summary – Surface Water/Seeps and QA/QC Water Samples**

| Method | Total Metals, (200.7 or 200.8 and 245.1) | Hardness (2340B) | Dissolved Metals (200.7 or 200.8 and 245.1) | Chloride and Sulfate (300A) | Total Dissolved Solids (2540C) | pH (9040) |
|---|---|---|---|---|---|---|
| Minimum Volume | 500 mL | | 500 mL | 500 mL | | |
| Sample Container | Glass or plastic | | Glass or plastic | Glass or plastic | | |
| Preservation | $HNO_3$<br>0 to 4°C | | $HNO_3$<br>0 to 4°C | No Preservative | | |
| Analysis Holding Time | 6 months/28 days for Hg | 6 months | 6 months/28 days for Hg | 28 days | 7 days | ASAP |
| Number of Samples: Seeps and Ponded Water | 15 | 15 | 15 | 15 | 15 | 15 |
| **Quality Assurance/Quality Control Samples** | | | | | | |
| Duplicate Samples (10%) | 2 | 2 | 2 | 2 | 2 | 2 |
| MS/MSD (5%) | 1 | 1 | 1 | 1 | 1 | 1 |
| Equipment Rinse Blank | 1 per day as needed | N/A | N/A | 1 per day as needed | N/A | 1 per day as needed |
| **Total Number of Samples** | **18** | **18** | **18** | **18** | **18** | **18** |

Key:

ASAP = As soon as possible
Hg = mercury
$HNO_3$ = Nitric Acid
mL = milliliter
MS/MSD = Matrix Spike/Matrix Spike Duplicate – extra volume will be collected for analysis
N/A = Not applicable
QA/QC = Quality Assurance/Quality Control

**Table 5-2 Sampling and Analysis Summary - Soil and Soil QA/QC Samples**

| Method | Total Metals, (6010B/7471) | Chloride and Sulfate (300A) | pH (9040) |
|---|---|---|---|
| Minimum Volume | 8 or 12 oz. | | |
| Sample Container | Glass or plastic | | |
| Preservation | No Preservative<br>0 to 4°C | | |
| Analysis Holding Time | 6 months | 28 days | ASAP |
| Number of Samples: Soil | 8 | 8 | 8 |
| **Quality Assurance/Quality Control Samples** | | | |
| Duplicate Samples (10%) | 1 | 1 | 1 |
| MS/MSD (5%) | 1 | 1 | 1 |
| **Total Number of Samples** | **10** | **10** | **10** |

Key:
ASAP = As soon as possible
mL = milliliters
oz. = ounce
QA/QC = Quality Assurance/Quality Control

# 6 Field Methods and Procedures

## 6.1 Field Procedures

The following sampling standard operating procedures (SOPs) are attached in Appendix C and will be used to guide the field procedures:

- E & E SOP No. ENV 3.13: Soil Sampling
- E & E SOP No. ENV 3.12: Surface Water Sampling
- E & E SOP No. ENV 3.15: Sampling Equipment Decontamination
- E & E SOP No. ENV 3.16: Sample Packaging and Shipping

Deviations from the SOPs will be documented in the field notes.

### 6.1.1 Equipment

The equipment listed in the next subsection may be utilized to obtain environmental samples. The START and EPA will determine which equipment to use in the field depending on site conditions and other factors, such as accessibility and soil conditions.

#### 6.1.1.1 Equipment Used

The following is a partial list of equipment that is anticipated to come in contact with soil and/or water samples:

- Peristaltic pump;
- Sterile dedicated plastic tubing;
- Shovels, hand augers, trowels, scoops; and
- Stainless-steel bowls or glass containers.

#### 6.1.1.2 Equipment Maintenance

Field instrumentation for the monitoring of water quality parameters listed in Section 4.1.1 will be operated, calibrated, and maintained by the sampling team in accordance with the SOPs listed in Section 6.1 or their equivalent. Field instrumentation utilized for health and safety purposes will be operated, calibrated, and maintained by the sampling team according to manufacturers' instructions. Calibration and field use data will be recorded in the instrument log books.

#### 6.1.1.3 Inspection/Acceptance Requirements for Supplies and Consumables

There are no project-specific inspection/acceptance criteria for supplies and consumables. It is standard operating procedure that personnel will not use broken or defective materials; items will not be used past their expiration date; supplies and consumables will be checked against order and packing slips to verify the correct items were received; and the supplier will be notified of any missing or damaged items.

### 6.1.2 Field Notes

Field notes are a daily requirement and will be kept by the START sample team in a site logbook. Details are described in Section 6.1.2.1.

#### 6.1.2.1 Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. A separate logbook will be maintained for each project. Logbooks are bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions. The following information will be recorded, as applicable, during the collection of each sample:

- Sample location and description;
- Site sketch showing sample location and measured distances;
- Sampler's name(s);
- Date and time of sample collection;
- Type of sample (matrix);
- Type of sampling equipment used;
- Onsite measurement data (e.g., temperature, pH, conductivity);

- Field observations and details important to analysis or integrity of samples (e.g., rain and odors);
- Type(s) of preservation used;
- Instrument reading (water quality meter);
- Shipping arrangements (air bill numbers); and
- Receiving laboratory(ies).

In addition to sampling information, the following specifics may also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities;
- Time of arrival onsite and time of departure;
- Other personnel on site;
- A summary of any meetings or discussions with any potentially responsible parties, or representatives of any federal, state, or other regulatory agency;
- Deviations from sampling plans, site safety plans, and SAP procedures;
- Changes in personnel and responsibilities as well as reasons for the change;
- Levels of safety protection;
- Calibration information for equipment used on-site; and
- Record of photographs.

#### 6.1.2.2 Photographs

As needed, photographs will be taken at representative sampling locations and at other areas of interest on site. They will serve to verify information entered in the field logbook. When a photograph is taken, the following information will be written in the logbook or will be recorded in a separate field photography log:

- Time, date, location, and, if appropriate, weather conditions;
- Description of the subject photographed; and
- Name of person taking the photograph.

#### 6.1.2.3 Sample Logging

The sampling team will prepare sample labels and chain-of-custody forms.

The following information will be recorded for each sample after collection:

- Sample name;
- Sample date and time;
- Number of sample bottles;
- Type of preservation;
- Analyses; and
- Sampler's name(s).

The field team will generate chain-of-custody forms for each cooler of samples packaged and sent to a laboratory. Each chain-of-custody form will refer to the shipping method and tracking number. Printed chain-of-custody forms will be submitted to the laboratory with the samples.

### 6.1.3 Field Measurements

The following measurements will be made in the field during the sample collection effort.

#### 6.1.3.1 Mapping Equipment

Sample points and site features will be located and documented with a GPS unit. The GPS will be used to assign precise geographic coordinates to sample locations on the site. The GPS mapping will be done by personnel trained in the use of the equipment and will be completed in accordance with the manufacturer's instructions. Expected output from the use of GPS mapping will be site maps with sample locations and major site features.

#### 6.1.3.2 Water Quality Measurements

Water quality measurements are listed in Section 4.1.1. These will be recorded in the logbook for each sample location.

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## 6.2 Surface Water and Seep Sampling Procedures

Sampling will begin at the farthest downstream location and proceed upstream to avoid disturbing sediments that could impact turbidity and contaminant concentrations in downstream locations. Surface water samples associated with the seeps will be collected as close to the source as possible.

Samples will be collected using a battery-operated peristaltic pump outfitted with dedicated silicone tubing. The dedicated silicone tubing will minimize the risk of cross-contamination during sample collection. The small diameter of the silicone tubing, compared to a hand dipped sample bottle, will allow water samples to be collected from shallow water with less potential to disturb and entrain the bed sediment. The water sample will be collected from a single location within the middle of the stream channel at the mid-depth water level. The silicone tubing will be held by a field team member, ensuring that the tubing is placed in the water upstream from where the field team member is standing. In the event that the stream is too large to wade, a sample will be collected from the bank in a safe location and the tubing will placed approximately 1 foot below the surface of the water in a flowing portion of the stream. Use of a peristaltic pump to collect the samples also will facilitate collection of the dissolved phase aliquots by allowing for direct filtration of the water with minimal sample handling. Dissolved metals aliquots will be collected following collection of the other aliquots using a dedicated in-line 0.45-micrometer filter. Approximately 100 milliliters of sample water will be purged from the in-line filter before the sample is collected. The surface water samples will be collected directly into the appropriate (pre-preserved, as applicable) pre-cleaned sample containers as described in Section 5.

All samples will then be placed into ice-filled coolers and kept chilled until delivery to the laboratory. A chain-of-custody record will be completed to accompany the samples to the laboratory. All samples and forms will undergo a QA review, and custody seals will be affixed to the completed sample cooler prior to shipment.

In the event that it is not possible to collect the water samples using a peristaltic pump, samples will be collected by hand-dipping the sample container directly into the creek water. Using adequate protective clothing (i.e., gloves and hip waders, as needed), the sample will be collected under the water surface by pointing the sample container upstream. The container will be upstream of the collector and care will be taken to avoid disturbing the substrate. For sample containers that have been pre-preserved, a separate pre-cleaned dedicated bottle will be used as a transfer container.

Following sample collection at each location, field parameters for pH, temperature, conductivity, oxidation-reduction potential, and dissolved oxygen, will be measured using a water-quality meter and recorded in the field logbook.

At the completion of sampling each location, GPS coordinates for the sample location will be recorded.

## 6.3 Soil Sampling Procedures

Soil samples will be grab samples and shall be collected from 0 to 3 inches below the ground surface using a dedicated plastic scoop or trowel. Additional samples will be collected at an unspecified depth, to be determined in the field. This depth will correspond with field observations of soil staining or at the depth limit of soft depositional material at the toe of the repository slope. Either a shovel or hand auger will be used to complete this excavation. Samples will be thoroughly homogenized in a dedicated plastic bowl or a large, re-sealable plastic bag and placed into the appropriate, pre-cleaned sample containers. Large rocks, cobbles, and organic detritus will be removed from the sampling site prior to sample collection. All samples will be placed in coolers and chilled with ice to $4^{o}$ C for storage and shipping to the analytical laboratory. Sample collection method(s) may need to be modified based on field conditions.

At the completion of sampling each point, GPS coordinates for the sample location will be recorded. All sample locations will be recorded in the field logbook as sampling is completed. A sketch, if needed, of the sample location will be entered into the logbook and any physical reference points will be labeled. If possible, distances to reference points will be given. Each surface soil sample shall be described and recorded in a field logbook by the sampler. Physical characteristics that will be documented are as follows.

- Color;
- Odor;
- Grain-size range and distribution;
- Particle mineralogy and lithology;
- Stratigraphy;
- Mineralization; and
- Observations of non-native materials (e.g., brick, wood, metal or other debris).

## 6.4 Field Decontamination Procedures

If required, decontamination activities will be conducted by the START in accordance with E & E SOP No. 3.15 (see Appendix C). All non-dedicated sample handling devices will be decontaminated according to the following procedure:

1. Non-phosphate detergent and deionized or distilled water wash using a brush to scrub solids from the surface.

2. Double de-ionized or distilled water rinse.

The soil collection devices will be decontaminated by brushing out the excess soil with coarse-hair brushes and wiping out with a paper towel. The device will then be washed in a bucket containing non-phosphate detergent and tap or deionized or distilled water. After the wash, the sampling device will be double rinsed with deionized or distilled water.

# 7 Disposal of Investigation-Derived Waste

In the process of collecting environmental samples at this site, several different types of potentially contaminated investigation-derived wastes (IDW) will be generated, including the following:

- Used personal protective equipment (PPE);
- Disposable sampling equipment; and
- Decontamination fluids and solids (e.g., towels)

The EPA's National Contingency Plan required that management of IDW generated during site investigations comply with all relevant or appropriate requirements to the extent practicable. This sampling plan will follow the Office of Emergency and Remedial Response Directive 9345.3-02 (May 1991), which provides the guidance for management of IDW during site investigations. Listed below are the procedures that will be followed for handling IDW. The procedures are flexible enough to allow the site investigation team to use its professional judgment on the proper method for the disposal of each type of IDW generated at each sampling location.

- Used PPE and disposable sampling equipment will be double bagged in plastic trash bags and disposed of in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE or dedicated equipment that is to be disposed of that can still be reused will be rendered inoperable before disposal.

- Decontamination fluids will consist of water with residual contaminants and/or non-phosphate detergent. These fluids will be allowed to infiltrate on site well away from all surface water bodies or will be left at the site to evaporate.

# 8 Sample Identification, Documentation, and Shipment

## 8.1 Sample Nomenclature

A unique, identifiable name will be assigned to each sample. Samples will have a prefix "GE" indicating the site where they were collected (Grey Eagle). The prefix will be followed by code to distinguish the matrix (SW – surface water, SE – seep, or SO – soil). All samples will have a final two-digit integer, a number representing the sampling location, based on the order the samples were collected from that area (generally downstream to upstream for both surface water and soil). Field duplicate samples will have the same designations as their originals except the sequential number will be 800; thus, the field duplicate of GE-SW-05 will be GE-SW-805. For equipment rinsate blanks (if needed), the collection date will follow the "GE" designation, and the letters "RB" will be substituted for the depth suffix. A summary of this sample naming system is shown in Table 8-1.

## 8.2 Container, Preservation, and Holding Time Requirements

All sample containers will have been delivered to the START in a pre-cleaned condition. Container, preservation, and holding time requirements are summarized in Tables 5-1 and 5-2.

## 8.3 Sample Labeling, Packaging, and Shipping

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. Sample labels will be affixed to the sample containers and will contain the following information:

- Sample name;
- Date and time of collection;
- Site name; and
- Analytical parameter and method of preservation.

**Table 8-1 Sample Numbering System**

| Location | Sample ID |
|---|---|
| Grey Eagle Tailings Repository | GE-matrix code-sample number |
| **Examples** | |
| Surface Water Sample, Sample Location 1<br>Soil Sample, Sample Location 5 | GE-SW-01<br>GE-SO-5 |
| Field Duplicate | GE-<matrix sample code>-800 plus # |
| Equipment Rinsate Blank | GE-<sample date>-RB |

Samples will be stored in a secure location pending shipment to the laboratory. Sample coolers will be retained in the custody of site personnel at all times or secured so as to deny access to anyone else. When samples are not under the direct control of the individual responsible for them, they will be stored in a locked container sealed with a custody seal.

The procedures for shipping soil and water samples are:

- Ice will be packed in double zip-lock plastic bags.
- The drain plug of the cooler will be sealed with tape to prevent melting ice from leaking.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage during shipment.
- Screw caps will be checked for tightness.
- Containers will have custody seals affixed so as to prevent opening of the container without breaking the seal.
- All glass sample containers will be wrapped in bubble wrap.
- All containers will be sealed in zip-lock plastic bags.

All samples will be placed in coolers with the appropriate chain-of-custody forms. All forms will be enclosed in plastic bags and affixed to the underside of the cooler lid. Bags of ice will be placed on top of and around samples. Empty space in the cooler will be filled with bubble wrap or styrofoam peanuts to prevent movement and breakage during shipment. Each ice chest will be securely taped shut with strapping tape, and custody seals will be affixed to the front, right, and back of each cooler.

Samples will be shipped for immediate delivery to the contracted laboratory. Upon shipping, the laboratory will be notified of:

- Sampling contractor’s name;

- Name of the site;
- Shipment date and expected delivery date;
- Total number of samples, by matrix, and for each sample the relative level of contamination (i.e., low, medium, or high), if known;
- Carrier; air bill number(s), method of shipment (e.g., priority);
- Irregularities or anticipated problems associated with the samples; and
- Whether additional samples will be sent; or if this is the last shipment.

## 8.4 Chain-of-Custody Forms and QA/QC Summary Forms

A chain-of-custody form will be maintained for all samples to be submitted for analysis, from the time the sample is collected until its final deposition. Every transfer of custody must be noted and a signature affixed. Corrections on sample paperwork will be made by drawing a single line through the mistake and initialing and dating the change. The correct information will be entered above, below, or after the mistake. When samples are not under the direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. The chain-of-custody form must include the following:

- Sample identification numbers;
- Identification of sample to be used for MS/MSD purposes;
- Site name;
- Sample date;
- Number and volume of sample containers;
- Required analyses;
- Signature and name of samplers;
- Signature(s) of any individual(s) with control over samples;
- Airbill number; and
- Note(s) indicating special holding times and/or detection limits.

The chain-of-custody form will be completed and sent with the samples for each laboratory and each shipment. Each sample cooler will contain a chain-of-custody form for all samples within the sample cooler.

A QA/QC sample summary form will be completed for each method and each matrix of the sampling event. The sample number for all blanks, reference samples, laboratory QC samples (MS/MSDs), and duplicates will be documented on this form. This form is not sent to the laboratory. The original form will be sent to the reviewer who is validating and evaluating the data; a photocopy of the original will be made for the project manager’s master file.

# 9 Quality Assurance and Quality Control

## 9.1 Field Quality Control Samples

The QA/QC samples described in the following subsections, which are also listed in Tables 5-1 and 5-2, will be collected during this investigation.

### 9.1.1 Equipment Blank Samples

If decontamination of field equipment is required, an equipment rinsate blank will be collected to evaluate field sampling and decontamination procedures on the soil sampling equipment during the course of fieldwork. Equipment rinsate blank samples will be collected at a rate of one per day of fieldwork.

### 9.1.2 Assessment of Sample Variability (Field Duplicate)

Duplicate split soil samples will be collected at selected sample locations. These locations will be chosen in the field based on field observations and will be collected at a rate of 1 for every 10 field samples. A duplicate split sample is a 50/50 split of a sample after collection and homogenization.

### 9.1.3 Laboratory Quality Control Samples

A laboratory QC sample, also referred to as an MS/MSD, is not an extra sample; rather, it is a sample that requires additional QC analyses and, therefore, may require a larger sample volume. The chain-of-custody records for these samples will identify them as laboratory QC samples. The location of laboratory QC samples will be selected at random. At a minimum, one laboratory QC sample per 20 samples (or one per delivery group), per matrix, for each analytical parameter will be submitted. If the data quality indicators (DQIs) for analytical parameters are not achieved, further data review will be conducted to assess the impact on data quality. Laboratory QC samples, including laboratory MS/MSD and field duplicate samples, will be selected randomly.

Additional sample volume will be submitted for all samples designated as laboratory QC samples and will be marked on the chain-of-custody to the fixed-base laboratory.

## 9.2 Analytical and Data Package Requirements

It is required that all samples be analyzed in accordance with EPA Methods listed in Tables 5-1 and 5-2. The laboratory is required to supply documentation to demonstrate that their data meet the requirements specified in the method. Analytical laboratory turnaround time for sample results is approximately 20 days. The laboratory will also provide all data electronically in a spreadsheet-compatible format or delimited text file.

Deliverables for this project must meet the guidelines in *Laboratory Documentation Requirements for Data Evaluation* (EPA Region 9 R9/QA/00.4.1, March 2001). The following deliverables are required:

- A copy of the chain-of-custody, sample log-in records, and a case narrative describing the analyses and methods used;

- Analytical data (results) for up to three significant figures for all samples, method blanks, MS/MSD, Laboratory Control Samples (LCS), duplicates, Performance Evaluation (PE) samples, and field QC samples;

- QC summary sheets/forms that summarize the following:
  - MS/MSD/LCS recovery summary,
  - Method/preparation blank summary,
  - Initial and continuing calibration summary (including retention time windows),
  - Sample holding time and analytical sequence (i.e., extraction and analysis),
  - Calibration curves and correlation coefficients,
  - Duplicate summary, and
  - Detection limit information;

- Analyst bench records describing dilution, sample weight, percent moisture (solids), sample size, sample extraction and cleanup, final extract volumes, and amount injected;

- Standard preparation logs, including certificates of analysis for stock standards;

- Detailed explanation of the quantitation and identification procedure used for specific analyses, giving examples of calculations from the raw data; and

- A final deliverable report consisting of sequentially numbered pages.

Note that the preceding data requirements are included to specify and emphasize general documentation requirements and are not intended to supersede or change requirements of each method.

## 9.3 Data Management

Samples will be collected and described in a logbook, as discussed in Section 6.1.2.1. Samples will be kept secure in the custody of the sampler at all times; the sampler will assure that all preservation parameters are followed. All samples that are to be sent to the analytical laboratory will be collected and logged on chain-of-custody forms as discussed in Section 8.4. A START member will only submit samples to the analytical laboratory with chain-of-custody documentation. All submitted samples will be in properly custody-sealed containers. Specifics are discussed in Section 8.3. The laboratories will note any evidence of tampering upon receipt.

All data summary reports and complete data packages will be archived by the project manager and stored in the START project file. The data validation reports and laboratory data summary reports will be included in the field reports submitted to the EPA and kept in the START project file.

All field data including field measurements will be managed in SCRIBE.

## 9.4 Data Validation

Data validation of all data will be performed by the START or their subcontractor in accordance with EPA Region 9 Superfund Data Evaluation/Validation Guidance R9QA/006.1, December 2001.

Standard data quality review requirements, including Tier 2 data validation of 100 percent of the data (as defined in Documentation of Data Validation Requirements in Quality Assurance Project Plans, Field Sampling Plans, and SAPs, EPA Region 9 Quality Assurance Office, January 2000), will satisfy the data quality requirements for this project. Upon completion of validation, data will be classified as one of the following: acceptable for use without qualifications, acceptable for use with qualifications, or unacceptable for use.

If during or after the evaluation of the project's analytical data it is found that the data contains excess QA/QC problems or if the data does not meet the DQI goals, then the independent reviewer may determine that additional data evaluation is necessary. Additional evaluation may include EPA Region 9 Superfund Data Evaluation/Validation Guidance R9QA/006.1 for evaluation Tier 3.

To meet evaluation and project requirements, the following criteria will be evaluated during a Tier 2 evaluation:

### Evaluation of Completeness

The data validator will verify that the laboratory sample information matches the field sampling information and that all the required items are included in the data package. If the data package is incomplete, the data validator will contact the laboratory, which must provide all missing information.

### Evaluation of Compliance

The actual data validation effort will follow the following briefly outlined procedures:

- Review the data to check field and laboratory QC data, to verify that holding times and acceptance and performance criteria were met, and to note any anomalous values;
- Review chromatograms, mass spectra, and other raw data if provided as backup information for any apparent QC anomalies;
- Ensure all analytical problems and corrections are reported in the case narrative and that appropriate laboratory qualifiers are added;
- For any problems identified, review concerns with the laboratory, obtain additional information, if necessary, and check all related data to determine the extent of the error; and
- Apply data qualifiers to the analytical results to indicate potential limitations on data usability.

The data validator will follow qualification guidelines stated in the START-3 procedures for Tier 2 Data Validation of ERS data. This procedure follows guidelines derived from:

- *EPA CLP National Functional Guidelines for Organic Data Review*, (EPA 540/R-99-008, October 1999) or EPA Contract Laboratory Program (CLP) National Functional Guidelines for Inorganic Data Review, (EPA 540/R-94/013, February 1994); and
- *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures* [EPA/540/G-90/004, Office of Solid Waste and Emergency Response (OSWER) Directive 9360.4-01, dated April 1990].

## 9.5 Field Variances

As conditions in the field may vary, it may become necessary to implement minor modifications to this plan. When appropriate, the START QA Coordinator will be notified of the modifications and a verbal approval obtained before implementing the modifications. Modifications to the original plan will be recorded in site records and documented in the final report.

## 9.6 Assessment of Project Activities

The following assessment activities will be performed by START:

- All project deliverables (SAP, Data Summaries, Data Validation Reports, Investigation Report) will be peer reviewed prior to submission to the EPA. In time critical situations, the peer review may be concurrent with the release of a draft document to the EPA. Errors discovered in the peer review process will be reported by the reviewer to the originator of the document, who will be responsible for corrective action; and

- The QA Coordinator will review project documentation (e.g., logbooks, chain-of-custody forms) to ensure the SAP was followed and that sampling activities were adequately documented. The QA Coordinator will document deficiencies, and the PM will be responsible for corrective actions.

### 9.6.1 Project Status Reports to Management

It is standard procedure for the START PM to report any issues to the EPA FOSC, as they occur, that arise during the course of the project which could affect data quality, data use objectives, the project objectives, or project schedules.

### 9.6.2 Reconciliation of Data with DQOs

Assessment of data quality is an ongoing activity throughout all phases of a project. The following outlines the methods to be used by START for evaluating the results obtained from the project.

Review of the DQO outputs and the sampling design will be conducted by the START QA Coordinator prior to sampling activities. The reviewer will submit comments to the START PM for action, comment, or clarification. This process will be iterative.

A preliminary data review will be conducted by the START. The purpose of this review is to look for problems or anomalies in the implementation of the sample collection and analysis procedures and to examine QC data for information to verify assumptions underlying the DQOs and the SAP. When appropriate to sample design, basic statistical quantities will be calculated and the data will be graphically represented.

When appropriate to the sample design and if specifically tasked to do so by the EPA FOSC, START will select a statistical hypothesis test and identify assumptions underlying the test.

# 10 References


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# A Data Quality Objectives

**Grey Eagle Tailings**
**Sediment Removal Assessment**

**Data Quality Objectives (DQO) Process Document**
**Objective Outputs**

**TDD No.: TO-02 09-11-08-0001**
**Job No.: 002693.2151.01RA**

*In August 2011, the United States Environmental Protection Agency (U.S. EPA) Region IX Emergency Response Section directed the Ecology and Environment, Inc. Superfund Technical Assessment and Response Team (START) to support a U.S. EPA-funded removal assessment of tailings adjacent to Indian Creek near Happy Camp, Siskiyou County, California. To support the U.S. EPA's environmental data collection activities, START has developed these project data quality objectives (DQOs) which will be used to develop the Grey Eagle Tailings Removal Assessment Sampling and Analysis Plan (SAP). These DQOs are included as Appendix A of the SAP.*

## 1. THE PROBLEM

**Background:**
The Grey Eagle Mine is located approximately five miles north of the town of Happy Camp, Siskiyou County, California. According to USEPA files, the mine is currently inactive and owned by the Siskon Gold Corporation of Grass Valley, CA. Exploration and mining began in 1895; sulfide copper ores were mined sporadically through the early half of the twentieth century under several operators. From 1941 to 1945, the Grey Eagle Mining Company (a subsidiary of Newmont Mining Company) operated a deep-tunnel copper mine. The ore was milled on site, and the tailings were pumped to the tailings site at the mouth of Luther Gulch, along Indian Creek. Along with copper, byproducts of gold and silver were also extracted from the millings. There is no evidence of activity at the mine from 1945 until 1981; the mine was owned by the Standard Slag Company of Reno, Nevada during this time. The Noranda Mining Company reopened the Grey Eagle Mine, extracting gold and silver from 1981 through 1986.

The tailings pile appears to have been generated during the 1941 to 1945 period of mining, when millings were sent by flume down to the site for cyanide extraction. In about 1952, a depression of approximately 450,000 ft^2 and 15 ft deep was constructed in the tailings pile and utilized as a log pond by a saw mill which was operated on the site by the Willamette Lumber Company (Willamette) from 1945 to 1965. Croman Corporation owned the property from 1975 to 1990; Siskon Gold Co. owned the property from 1990 to 1996. There is no report of tailings having been dumped on the site during the mining activity in the 1980s. The property is currently privately owned by B. McCoy, the former site caretaker.

Data from a 1996 assessment indicate that there is no residual cyanide from the extraction process which took place from 1941-1945; the main concerns at the tailings site are the heavy metal concentrations in the sulfide deposits and the acidic conditions caused by the oxidation of the sulfide phases present. In 1998, under the direction of the U.S. EPA, START performed an assessment that demonstrated groundwater is present at depth in the tailings pile and that only the uppermost surface of the tailings was oxidized.

A remedial action was then completed in 1998 that consolidated the tailings in the former log pond and capped the material with an impervious plastic liner then native soil and vegetation to limit the infiltration of atmospheric oxygen into the tailings pile. Tailings were removed from a small parcel of land owned by the USFS and consolidated in the log pond. The southern berm of the log pond was removed and re-graded to a slope of two percent. The surface of the capped areas was graded to 1.5% and a surface drain system was constructed to facilitate stormwater drainage from the surface of the cap. Finally rip rap was installed at the base of the tailings pile adjacent to a side-channel of Indian Creek to protect the tailings from erosion. All of these items appeared to be intact as of a site visit in August 2011.

**Conceptual Site Model:**

- The media of concern is water (surface and seeps) and areas of soil potentially impacted by the seep discharges at the site.
- The principal COPCs are copper, arsenic and acidic conditions.
- The water and soil at the site were potentially contaminated with COPCs due to groundwater percolating through the previously-capped tailings and surface and stormwater runoff from the eroded soil from adjacent uncapped tailings.

**Exposure Scenario:**

Current Conditions

- Concerns based on current conditions include: 1) direct exposure of human and/or environmental receptors to seeps and soil impacted by seeps that discharge from the tailings repository and likely contain elevated concentrations of COPCs, 2) direct exposure of human and/or environmental receptors to COPCs in uncapped tailings, and 3) exposure to fish or other organisms such as plants and invertebrates that may contain elevated levels of COPCs in their tissues due to bioaccumulation.

**Planning Team:**

Mr. Christopher Weden, U.S. EPA Federal On-Scene Coordinator (FOSC)
Mr. Howard Edwards, START Quality Assurance Coordinator
Mr. Derek Ormerod, START Project Manager
Analytical Laboratory – U.S. EPA Region IX lab, EPA Contract Laboratory Program (CLP) lab, or START Basic Ordering Agreement (BOA) lab.

**The Roles and Responsibilities for this Investigation are as Follows:**

- **Christopher Weden, U.S. EPA FOSC**, will be the primary decision-maker and will direct the project, specify tasks, and ensure that the project is proceeding on schedule and is within budget. Additional duties include coordination of all preliminary and final reporting and communication with the START Project Manager.
- **Howard Edwards, START Quality Assurance Coordinator**, will provide quality assurance oversight to ensure that planning and plan implementation are in accordance with U.S. EPA regional quality assurance/quality control (QA/QC) protocol. He will provide technical direction concerning QA/QC as needed to the U.S. EPA FOSC and the START project manager.
- **Derek Ormerod, START Project Manager**, will coordinate with the planning team to develop objectives and complete an approved SAP. START will have the responsibility for implementation of the SAP, coordination of project tasks, coordination of field sampling, project management, and completion of all preliminary and final reporting.

**Available Resources:**

The current START budget for environmental data collection activities and reporting is $75,921 for activities related to the planning, sampling, data collection, evaluation, and reporting for the Grey Eagle Tailings Removal Assessment. The EPA Region IX lab will be used as the analytical laboratory.

**Other Considerations and Constraints Related to Problem and Resources:**

- The analytical laboratory will be the U.S. EPA Region IX lab, however an additional START subcontracted lab may need to be used to provide sufficient reporting limits for arsenic in the soil samples.
- This investigation is intended to provide information on whether observed seeps are impacting Indian Creek. Additional data regarding the source and nature of groundwater may need to be collected at a later date to provide information about potential engineering solutions.

## 2. THE DECISION

**Principal Study Questions:**

Principal Study Question #1: Do the seeps discharging from the tailings repository contain COPCs and at what concentrations?

Principal Study Question #2: What is the impact to Indian Creek water quality from the site and other adjacent drainages that may be impacted by the mine infrastructure?

Principal Study Question #3: Have the seeps adversely impacted soil at the toe of the tailings repository?

**Actions that could Result from Resolution of the Study Questions:**

If it is resolved that the COPCs in the seeps or site soils do not exceed any action level, then the information may be used to support a determination that no further action is needed.

If it is resolved that the COPCs in seeps are present at concentrations that exceed action levels, additional investigations of groundwater conditions may be executed to guide planning potential remedial actions.

If it is resolved that the COPCs in the seeps and surface water contain concentrations that exceed action levels, then a removal action or remedy for the portion of uncapped tailings may be warranted.

**Decision Statement(s):**

Determine the presence, and if applicable concentrations, of COPCs and the impact of surface water and seep discharges to Indian Creek from the site in order to assist U.S. EPA's determination of the need to conduct a remedial action.

## 3. DECISION INPUTS

**Sources of Information Currently Available:**

- Unpublished Water Quality Data Provided by North Coast Water Quality Board, presented by Clayton Creager, collection date currently unknown.
- Water Quality Data provided by Mid Klamath Watershed Council, presented by Will Harding, collection date April, 2008.
- Water Quality Data provided by Klamath Riverkeeper, presented by Will Harding, collection date: 2 events in 2010. Results currently pending.

**New Environmental Data Required to Resolve the Decision Statements:**

- COPC data of discharge from seeps;
- COPC data of stained soil at toe of tailings repository;
- COPC data in Indian Creek above and below site;
- COPC data from other potentially impacted tributaries entering Indian Creek (Baker Gulch, Luther Gulch, and Deer Lick Creek).

**Sources of Information to Resolve the Decision Statements:**

- Analytical data from proposed sampling.

**Information Needed to Establish Action Level:**
Action levels for COPCs come from the following sources:

- U.S. EPA National Recommended Water Quality Standards values are Chronic Contaminant Concentrations for Freshwater.
- Where applicable the Standards from the Water Quality Control Plan for the North Coast Region were used applying the Mid Klamath River HA for "Other Streams".
- For Soils, the Regional Screening Levels for Contaminants at Superfund Sites were used from the U.S. EPA Regional Screening Tables Website.
- Where applicable for soils, the Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil was used from the California Environmental Protection Agency.

**Measurement Methods**:
Collected water samples can be definitely analyzed to determine COPC concentrations by several U.S. EPA methods as follows:

- Total metals by EPA 200.7 or 200.8 and 245.1 for mercury;
- Dissolved metals by EPA 200.7 or 200.8 and 245.1 for mercury;
- Chloride and Sulfate by EPA 300.0;
- Hardness by EPA 2340B
- pH by EPA 9040
- Total Dissolved Solids by EPA 2540C

Soil samples collected will be analyzed for COPCs by the following methods:

- Total metals by EPA 6010B/7471;
- Chloride and Sulfate by EPA 300.0;
- pH by EPA 9040

**Confirm that Appropriate (Analytical) Methods Exist to Provide the Necessary Data:**
All indicated definitive methods have sufficient sensitivity, accuracy, precision, and other quality parameters to generate necessary data. See Section 3.3 and Table 3-1 of the SAP for additional information.

## 4. DEFINE THE STUDY BOUNDARIES

**Specific Characteristics that Define Problem Being Studied**:

- The COPC concentrations in surface water and stained soil within the specified spatial and temporal boundaries.
- The temporal changes of COPCs in surface water and seeps during seasonal flow extremes.

**Spatial Boundaries:**

New data will be generated from samples collected from the site. The investigation boundaries for the site center on the previous tailings repository and the impacts to adjacent Indian Creek. The investigation also extends upstream on Indian Creek above the confluence with Baker Gulch and downstream below the confluence with Deer Lick Creek. The investigation will also extend to the water quality inputs of three tributaries: Baker Gulch, Luther Gulch and Deer Lick Creek, to determine the water quality inputs to Indian Creek from these tributaries. In addition, two side channels of Indian Creek will be investigated: one at the toe of the slope that contains the tailing repository and the other upstream adjacent to where Baker and Luther Gulch enter Indian Creek.

**Temporal Boundaries:**

Sampling will occur during 3 different hydrologic regimes to provide information regarding the seasonal variation of potential COPCs discharging from the previously-capped tailings piles and to determine seasonal variations in surface water, if they exist.

COPC concentrations may vary seasonally depending on stormwater flow, ground and surface water variations and other natural occurrences. The timeframe of the planned sampling investigation is intended to capture the following conditions:

- Low stream flow / low groundwater conditions (September 2011);
- High stream flow / low groundwater conditions (October/November 2011); and
- Moderate stream flow / high groundwater conditions (Spring 2012).

**Practical Constraints on Data Collection:**

Physical Constraints:

- Varying water levels may make some sampling locations impractical or unsafe to access at higher flow conditions.
- Dense vegetation may make some locations difficult to access.

Other Constraints on Data Collection

- Atypical weather patterns may vary the anticipated dates of the surface and ground water flow conditions described above.
- The number and location of seeps may vary at different times of the year.
- The turnaround times on data are always estimated and cannot be assured. Sample and system problems may indiscriminately increase data turnaround times.
- Definitive data will undergo an EPA Region IX Tier 1A validation prior to final reporting.

## 5. DECISION RULE

**Statistical Parameter:**
Statistical analysis is not a part of this investigation. The sampling is intended to provide a snapshot view of the site, the site discharges, and background creek conditions over a variety of seasonal conditions.

Minor statistical analysis may however be used to determine basic parameters such as the range of contaminant concentrations, average concentration, and contamination variability over the time range of sampling events. It will be necessary to consider an individual sampling data point as representing the contaminant concentration within a specific area.

**Action Level:**
At the direction of the FOSC, the action levels for the Grey Eagle Removal Assessment are the U.S. EPA Water Quality Standards for Freshwater, using the Chronic Contaminant Concentrations. Additional action levels are provided in the North Coast Regional Water Quality Basin Plan, where applicable. Refer to Table 5.1 of the SAP for water quality action levels.

**Decision Rule:**
If the new data indicates that contaminant concentrations in water discharging to Indian Creek are adversely impacting water quality in Indian Creek, then decision-makers will decide what appropriate remedial actions will be investigated in order to protect human health and/or the environment.

## 6. LIMITS ON DECISION ERRORS

**Range of the Parameter(s) of Interest:**
For all investigation areas and parameters, the range of interest for COPCs is from ½ the action level to anything above the action levels. Quantitatively precise and accurate determinations of contaminant concentrations that are significantly above (i.e., >100 times) the action level are not necessary.

Based upon previous investigations, surface water containing metals and low pH are expected to be present at the site. Concentrations are unknown.

**Baseline Condition *(The Null Hypothesis)*:**
The contaminant concentrations in surface water or soil are equal to or greater than the action levels.

**Alternative Condition *(The Alternative Hypothesis)*:**
The contaminant concentrations in surface water or soil are less than action levels.

**Decision Error**
A discussion of decision error is presented in Table 6-1.

| **TABLE 6-1 DECISION ERROR**<br>**Surface Water and Seeps** | | |
|---|---|---|
| ***Decision Error*** | Deciding that the site is contaminated and requires additional investigation and mitigation when the site is not contaminated. | Deciding that the site is not contaminated and does not require additional investigation or mitigation when the site is contaminated. |
| ***True Nature of Decision Error*** | The sample concentrations are either not representative or are biased high. | The sample concentrations are either not representative or are biased low. |
| ***The Consequence of Error*** | 1) The site will either undergo additional investigation or additional mitigating activities. These situations would cost additional resources including time, money, and manpower and could negatively impact the environment. | 1) The contaminated seeps from the tailings pile could continue to discharge COPCs to Indian Creek and to aquatic organisms and humans.<br>2) The contamination could migrate further downstream in Indian Creek. |
| ***Which Decision Error Has More Severe Consequences near the action level?*** | **LESS SEVERE**<br>to human health, but with appreciable economic consequences. | **MORE SEVERE**<br>because the contaminated water may pose risks to human health and/or the environment. |
| ***Error Type Based on Consequences*** | **False Acceptance Decisions**<br><br>A decision that the area is contaminated when it is not. | **False Rejection Decisions**<br><br>A decision that the area is not contaminated when it is. |
| **Definitions**<br>False Acceptance Decisions = A false acceptance decision error occurs when the null hypothesis is not rejected when it is false.<br>False Rejection Decisions = A false rejection decision error occurs when the null hypothesis is rejected when it is true. | | |

**Decision Error Limits Goals**

Decision Error Limits goals stated in Table 6-2.

**TABLE 6-2 DECISION ERROR LIMIT GOALS**
**Surface Water and Seeps**

| True Average Concentration of Site (% of Action Level) | Decision Error | Typical Decision Error Probability Goals (Based on Professional Judgment) | Type of Decision Error |
|---|---|---|---|
| <75 % | A decision that the site or portion of the site is contaminated when it is not. | less than 5 % | False Acceptance |
| 75 to <100 % AL | A decision that the site or portion of the site is contaminated when it is not. | Gray Area [1] | False Acceptance |
| 100 to 150 % AL | A decision that the site or portion of the site is not contaminated when it is. | 10 % [2] | False Rejection |
| > 150 % | A decision that the site or portion of the site is not contaminated when it is. | less than 1% | False Rejection |

**The goals in this table are based on professional judgment as relevant to the Sediment Removal Assessment.**

[1] Gray Area is where relatively large decision errors are acceptable.

[2] Note that relatively large decision errors are expected when the true contaminant concentrations are between 100 and 150 % of the action level. Decreasing the probability is not possible since sampling and analytical uncertainties and biases cannot be eliminated.

## 7. OPTIMIZED DESIGN FOR OBTAINING DATA

**General:**
All activities and documentation related to the project should proceed under a Quality Management Plan (QMP). All sampling, analytical and quality assurance activities will proceed under a U.S. EPA-approved SAP. A record of sampling activities and deviation from the SAP must be documented in a bound field log book. Prior to sample collection, all project sampling personnel will review relevant sampling procedures and relevant quality assurance and control (QA/QC) requirements for selected analytical methods.

**Decision Error Minimization:**

Average Concentrations
In order to minimize a decision error related to data uncertainty, the decision-maker should consider statistical evaluations of the data prior to making decisions.

Data from Individual Sample Locations
The decision-maker should consider data uncertainty when making decisions based upon sampling data and associated estimated values based upon a single location. An individual data value reported below the action level may potentially be biased low, while a data value reported above of the action level may potentially be biased high. The probability of decision errors increase at COPC concentrations around the action level due to both data uncertainty and data bias.

For any reported values near the method detection limit, the uncertainty of any given value is even greater. Thus the probability of decision error is greatly increased at COPC concentration near detection limits. The uncertainty for estimated data (i.e., data based on extrapolations and interpolations) is typically greater than for actual data. Therefore, the probability of decision errors is greatly increased for extrapolated data.

Contamination Background Sampling
Data collected from background sampling locations, both upstream and downstream of the site, plus in the tributaries to Indian Creek, may be influenced by a number of factors outside of direct impacts from the tailings. There is the potential for runoff from other portions of the mine or from other unknown sources and may not be directly attributable to the capped and un-capped tailings at the repository, which is the focus of this investigation. The decision-maker should consider our COPC sources in the watershed and may wish to review other remedial actions or investigations.

**Specific Design Optimization:**
Based upon the project's goals and objectives, the Planning Team considered the following design elements as necessary to achieve DQOs:

- The collection and analysis of water discharging from the seeps and pockets of ponded water for dissolved and total metals, pH, total dissolved solids (TDS) and anions (chloride and sulfate).
- The collection and analysis of surface water from Indian Creek, upstream and downstream of the site, plus from Baker Gulch, Luther Gulch and Deer Lick Creek for dissolved and total metals pH, total dissolved solids (TDS) and anions (chloride and sulfate).
- Collection of soil samples at the toe of the tailings repository in areas where staining is observed to determine possibility of soil contamination and extent of depth of contamination.
- Delineation of stained soil areas downstream from the tailings repository to determine the potential for a downstream migration pathway to Indian Creek.

Samples from the multiple areas will be collected to meet the specified DQO's. The primary focus of this investigation is characterizing the impacts to Indian Creek from water observed to be discharging from the capped tailings at the repository. Sample collection at this portion of the investigation is dependent on where water is observed discharging during the sampling event. Based on an August 2011 site visit, a minimum of three samples can be collected:

- One sample from each of the two seeps at the upstream portion of the tailings that discharges directly to Indian Creek;
- One sample from the ponded water at the downstream edge of the capped tailings.

Three additional samples will be reserved for the time of the field investigation and will be located in either additional seeps or at additional ponded areas that exhibit oxide staining, with a preference given to seeps and a second preference given to locations with observed staining.

Surface water samples will be collected from Indian Creek and its tributaries to characterize surface water conditions. One surface water sample will be collected at each of the following locations:

- Indian Creek: upstream of confluence with Baker and Luther Gulch;
- Indian Creek side-channel in vicinity of Baker/Luther Gulch confluence;
- Indian Creek: downstream of Baker/Luther Gulch confluence and upstream of tailings repository;
- Indian Creek: downstream of initial 2 seeps that discharge directly to Indian Creek;
- Indian Creek: downstream of side channel that collects discharge at the toe of the repository;
- Indian Creek: downstream of the confluence with Deer Lick Creek;
- Baker Gulch: upstream of the confluence with Luther Gulch;
- Luther Gulch: upstream of the confluence with Baker Gulch; and
- Deer Lick Creek: upstream of the confluence with Indian Creek.

Stream samples will be collected in well-mixed areas and are intended to be representative of overall water quality at the specified reach. Samples will not be targeted as worst-case scenarios, but will focus on representative conditions. If possible samples will be collected in the central portion of the channel at approximately 1-foot below the water surface.

All surface water samples will be collected with a battery-operated peristaltic pump and dedicated tubing. Efforts will be made, particularly in the ponded water and seep samples, to collect only surface water and not disturb the sediment.

Soil samples will be collected at areas of observed staining along the toe of the tailings repository. The exact areas will be determined in the field based on site conditions and observations, but a maximum of 8 total soil samples will be collected in this area. These samples will include both a surface soil sample and a sample at depth. The depth of the bottom sample will be determined in the field based on visual observations of staining and will attempt to determine a maximum depth of observed contamination, if this is relevant. Samples will be collected with either a shovel or hand auger. These soil sample locations may extend further downstream along the Indian Creek side channel beyond the tailings repository, depending on observations.

At least 2 additional soil samples will be collected from the soil that contains precipitated salts observed in association with the two seeps at the upstream portion of the tailings reservoir. These will both be surface samples only and are intended to better characterize the discharge from the seeps.

GPS locations will be collected at all sampling locations to provide documentation of locations and to allow the same locations to be sampled at subsequent sampling events.

**Analysis:**
All surface water samples collected will be analyzed for COPCs by the following methods:

- Total metals by EPA 200.7 or 200.8 and 245.1 for mercury;
- Dissolved metals by EPA 200.7 or 200.8 and 245.1 for mercury;
- Chloride and Sulfate by EPA 300.0;
- Hardness by EPA 2340B
- pH by EPA 9040
- Total Dissolved Solids by EPA 2540C

Samples collected for Total Dissolved Metals will be field filtered using a 0.45 micron filter.

All soil samples collected will be analyzed for COPCs by the following methods:

- Total metals by EPA 6010B/7471;
- Chloride and Sulfate by EPA 300.0;
- pH by EPA 9040

The U.S. EPA Region IX laboratory will perform the analytical services.

# B Site-Specific Health and Safety Plan

ECOLOGY AND ENVIRONMENT, INC.

# SITE-SPECIFIC HEALTH AND SAFETY PLAN

Project: Grey Eagle Mine

Project No.: 002693.2151.01RA

TDD/PAN No.: TO-02-09-11-08-0001

Project Location: Siskiyou County, California (41° 51' 27" latitude, 123° 23' 54" longitude)

Proposed Date of Field Activities: August - December 2011

Project Director: Cindy McLeod

Project Manager: Derek Ormerod

Prepared by: Kate Villars

Date Prepared: September 6, 2011

Approved by:

Date Approved: 9/12/2011
9/15/11

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# 1. INTRODUCTION

## 1.1 POLICY

It is E & E's policy to ensure the health and safety of its employees, the public, and the environment during the performance of work it conducts. This site-specific health and safety plan (SHASP) establishes the procedures and requirements to ensure the health and safety of E & E employees for the above-named project. E & E's overall safety and health program is described in *Corporate Health and Safety Program* (CHSP). After reading this plan, applicable E & E employees shall read and sign E & E's Site-Specific Health and Safety Plan Acceptance form.

This SHASP has been developed for the sole use of E & E employees and is not intended for use by firms not participating in E & E's training and health and safety programs. Subcontractors are responsible for developing and providing their own safety plans.

This SHASP has been prepared to meet the following applicable regulatory requirements and guidance:

| Applicable Regulation/Guidance |
|---|
| 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER) |
| Other: |

## 1.2 SCOPE OF WORK

Description of Work: Grey Eagle mine is located in Klamath National Forest approximately 5 miles north of the town of Happy Camp, California. START previously conducted assessment and oversight work to grade, cap, and reinforce mine tailing piles on site. Recent observations suggest that metals may still be entering Indian Creek from ground water in the tailings pile immediately adjacent to the creek. START will conduct sampling of soil, surface water, and groundwater seeps in the stream bank to characterize potential metals contamination.

Equipment/Supplies: Attachment 1 contains a checklist of equipment and supplies that will be needed for this work.

The following is a description of each numbered task:

| Task Number | Task Description |
|---|---|
| 1 | Sampling – Surface Water |
| 2 | Sampling – Groundwater seeps from stream bank and associated precipitated salts |
| 3 | Sampling – soil |
| 4 | Decontamination |
| 5 | Site Documentation – GPS, photographic and written |
| | |
| | |

## 1.3 SITE DESCRIPTION

Site Map: A site map or sketch is attached at the end of this plan.

Site History/Description (see project work plan for detailed description): Grey Eagle mine is located in Klamath National Forest, five miles north of Happy Camp, CA. The mine is currently inactive, but tailings piles adjacent to Indian Creek contain unoxidized heavy metals and, despite capping in 1998, are suspected of negatively impacting water quality in the creek. A 1998 START assessment demonstrated that groundwater is present at depth in the tailings pile and that only the uppermost surface of the tailings was oxidized. Recent observations suggest heavy metals may be entering Indian Creek and creating acidic conditions through oxidation.

Is the site currently in operation? ☐ Yes ☒ No

Locations of Contaminants/Wastes: Mine wastes with documented elevated levels of arsenic, copper, and mercury are located in the capped tailings pile adjacent to Indian Creek. Sampling will be conducted on surface water in Indian Creek, ground water seeps on the creek bank, precipitated salts from these seeps, and soils in the area of the tailings adjacent to the creek to characterize the suspected migration of contaminants into surface water.

Types and Characteristics of Contaminants/Wastes:

| | | | |
|---|---|---|---|
| ☒ Liquid | ☒ Solid | ☒ Sludge | ☐ Gas/Vapor |
| ☐ Flammable/Ignitable | ☐ Volatile | ☐ Corrosive | ☐ Acutely Toxic |
| ☐ Explosive | ☐ Reactive | ☒ Carcinogenic | ☐ Radioactive |
| ☐ Medical/Pathogenic | Other: ______ | | |

## 2. ORGANIZATION AND RESPONSIBILITIES

E & E team personnel shall have on-site responsibilities as described in E & E's standard operating procedure (SOP) for Site Entry Procedures (GENTECH 2.2). The project team, including qualified alternates, is identified below.

| Name | Site Role/Responsibility |
|---|---|
| Derek Ormerod | Project/Task Manager, Site Safety Officer |
| Kate Villars | Field Support |
| | |
| | |
| | |
| | |

## 3. TRAINING

Prior to work, E & E team personnel shall have received training as indicated below. As applicable, personnel shall have read the project work plan, sampling and analysis plan, and/or quality assurance project plan prior to project work.

| Training | Required |
|---|---|
| 40-Hour OSHA HAZWOPER Initial Training and Annual Refresher (29 CFR 1910.120) | X |
| Annual First Aid/CPR | X |
| Hazard Communication (29 CFR 1910.1200) | X |
| 40-Hour Radiation Protection Procedures and Investigative Methods | |
| 8-Hour General Radiation Health and Safety | |
| Radiation Refresher | |
| DOT and Biannual Refresher | |
| Other: ______________________________ | |

## 4. MEDICAL SURVEILLANCE

### 4.1 MEDICAL SURVEILLANCE PROGRAM

E & E field personnel shall actively participate in E & E's medical surveillance program as described in the CHSP and shall have received, within the past year, an appropriate physical examination and health rating.

E & E's health and safety record (HSR) form will be maintained on site by each E & E employee for the duration of his or her work. E & E employees should inform the site safety officer (SSO) of any allergies, medical conditions, or similar situations that are relevant to the safe conduct of the work to which this SHASP applies.

Is there a concern for radiation at the site? ☐ Yes ☒ No

If no, go to 5.1.

### 4.2 RADIATION EXPOSURE

#### 4.2.1 External Dosimetry

Thermoluminescent Dosimeter (TLD) Badges: TLD badges are to be worn by all E & E field personnel.

Pocket Dosimeters: ______________________________

______________________________

Other: ______________________________

______________________________

#### 4.2.2 Internal Dosimetry

☐ Whole body count ☐ Bioassay ☐ Other

Requirements: ______________________________

______________________________

#### 4.2.3 Radiation Dose

Dose Limits: E & E's radiation dose limits are stated in the CHSP. Implementation of these dose limits may be designated on a site specific basis.

Site-Specific Dose Limits:

ALARA Policy: Radiation doses to E & E personnel shall be maintained as low as reasonably achievable (ALARA), taking into account the work objective, state of technology available, economics of improvements in dose reduction with respect to overall health and safety, and other societal and socioeconomic considerations.

## 5. SITE CONTROL

### 5.1 SITE LAYOUT AND WORK ZONES

Site Work Zones: Refer to the map or site sketch, which will be produced on site, for designated work zones.

Site Access Requirements and Special Considerations: Grey Eagle Mine Tailings Repository can be accessed by driving approximately 5 miles north of Happy Camp, CA on Indian Creek Road and turning left on a private driveway approximately 100 feet before Luther Gulch Road. Collection of some sediment and water samples may require wading in Indian Creek if water conditions are safe.

Illumination Requirements: Work will be conducted during daylight hours. In the event that nighttime work is required, proper illumination of working areas is required.

Sanitary Facilities (e.g., toilet, shower, potable water): The nearest sanitary facilities will be located on the way to the site. Bottled water will be brought to site.

On-Site Communications: Person to person; cell phones if coverage is available

Other Site-Control Requirements:

### 5.2 SAFE WORK PRACTICES

Daily Safety Meeting: A daily safety meeting will be conducted for all E & E personnel and documented on the Daily Safety Meeting Record form or in the field logbook. The information and data obtained from applicable site characterization and analysis will be addressed in the safety meetings and also used to update this HASP, as necessary.

Work Limitations: Work shall be limited to a maximum of 12 hours per day. If 12 consecutive days are worked, at least one day off shall be provided before work is resumed. Work will be conducted in daylight hours unless prior approval is obtained and the illumination requirements in 29 CFR 1910.120(m) are satisfied.

Weather Limitations: Work shall not be conducted during electrical storms. Work conducted in other inclement weather (e.g., rain, snow) will be approved by project management and the regional safety coordinator or designee.

Other Work Limitations: ______________________________

______________________________

Buddy System: Field work will be conducted in pairs of team members according to the buddy system.

Line of Sight: Each field team member shall remain in the line of sight and within verbal communication of at least one other team member.

Eating, Drinking, and Smoking: Eating, drinking, smoking, and the use of tobacco products shall be prohibited in the exclusion and contamination reduction areas, at a minimum, and shall only be permitted in designated areas.

Contamination Avoidance: Field personnel shall avoid unnecessary contamination of personnel, equipment, and materials to the extent practicable.

Sample Handling: Protective gloves of a type designated in Section 7 will be worn when containerized samples are handled for labeling, packaging, transportation, and other purposes.

______________________________

Other Safe Work Practices: Personal floatation devices (PFDs) will be worn by E&E personnel at all times when wading or collecting samples along the stream bank.

# 6. HAZARD EVALUATION AND CONTROL

## 6.1 PHYSICAL HAZARD EVALUATION AND CONTROL

Potential physical hazards and their applicable control measures are described in the following table for each task.

| Hazard | Task Number | Hazard Control Measures |
|---|---|---|
| Biological (flora, fauna, etc.) | 1-5 | ■ Potential hazard: poison oak, insects (ticks, mosquitoes), animals (bears, snakes, etc.)<br>■ Establish site-specific procedures for working around identified hazards.<br>■ Other: |
| Cold Stress | 1-5 | ■ Provide warm break area and adequate breaks.<br>■ Provide warm noncaffeinated beverages.<br>■ Promote cold stress awareness.<br>■ See *Cold Stress Prevention and Treatment* (attached at the end of this plan if cold stress is a potential hazard). |

| Hazard | Task Number | Hazard Control Measures |
|---|---|---|
| Compressed Gas Cylinders | | ■ Use caution when moving or storing cylinders.<br>■ A cylinder is a projectile hazard if it is damaged or its neck is broken.<br>■ Store cylinders upright and secure them by chains or other means.<br>■ Other: |
| Confined Space | | ■ Ensure compliance with 29 CFR 1910.146.<br>■ See SOP for Confined Space Entry. Additional documentation is required.<br>■ Other: Confined spaces may be present within vessels that require assessment/sampling. |
| Drilling | | ■ See SOP for Health and Safety on Drilling Rig Operations. Additional documentation may be required.<br>■ Landfill caps will not be penetrated without prior discussions with corporate health and safety staff.<br>■ Other: |
| Drums and Containers | | ■ Ensure compliance with 29 CFR 1910.120(j).<br>■ Consider unlabeled drums or containers to contain hazardous substances and handle accordingly until the contents are identified.<br>■ Inspect drums or containers and assure integrity prior to handling.<br>■ Move drums or containers only as necessary; use caution and warn nearby personnel of potential hazards.<br>■ Open, sample, and/or move drums or containers in accordance with established procedures; use approved drum/container-handling equipment.<br>■ Other: |
| Electrical | | ■ Ensure compliance with 29 CFR 1910 Subparts J and S.<br>■ Locate and mark energized lines.<br>■ De-energize lines as necessary.<br>■ Ground all electrical circuits.<br>■ Guard or isolate temporary wiring to prevent accidental contact.<br>■ Evaluate potential areas of high moisture or standing water and define special electrical needs.<br>■ Other: |
| Excavation and Trenching | | ■ Ensure that excavations comply with and personnel are informed of the requirements of 29 CFR 1926 Subpart P.<br>■ Ensure that any required sloping or shoring systems are approved as per 29 CFR 1926 Subpart P.<br>■ Identify special personal protective equipment (PPE) (see Section 7) and monitoring (see Section 8) needs if personnel are required to enter approved excavated areas or trenches.<br>■ Maintain line of sight between equipment operators and personnel in excavations/trenches. Such personnel are prohibited from working in close proximity to operating machinery.<br>■ Suspend or shut down operations at signs of cave in, excessive water, defective shoring, changing weather, or unacceptable monitoring results. |

| Hazard | Task Number | Hazard Control Measures |
|---|---|---|
| | | ■ Other: |
| Fire and Explosion | | ■ Inform personnel of the location(s) of potential fire/explosion hazards.<br>■ Establish site-specific procedures for working around flammables.<br>■ Ensure that appropriate fire suppression equipment and systems are available and in good working order.<br>■ Define requirements for intrinsically safe equipment.<br>■ Identify special monitoring needs (see Section 8).<br>■ Remove ignition sources from flammable atmospheres.<br>■ Coordinate with local fire-fighting groups regarding potential fire/explosion situations.<br>■ Establish contingency plans and review daily with team members.<br>■ Other: |
| Heat Stress | 1-5 | ■ Provide cool break area and adequate breaks.<br>■ Provide cool noncaffeinated beverages.<br>■ Promote heat stress awareness.<br>■ Use active cooling devices (e.g., cooling vests) where specified.<br>■ See *Heat Stress Prevention and Treatment* (attached at the end of this plan if heat stress is a potential hazard). |
| Heavy Equipment Operation | | ■ Define equipment routes, traffic patterns, and site-specific safety measures.<br>■ Ensure that operators are properly trained and equipment has been properly inspected and maintained. Verify back-up alarms.<br>■ Ensure that ground spotters are assigned and informed of proper hand signals and communication protocols.<br>■ Identify special PPE (Section 7) and monitoring (Section 8) needs.<br>■ Ensure that field personnel do not work in close proximity to operating equipment.<br>■ Ensure that lifting capacities, load limits, etc., are not exceeded.<br>■ Other: |
| Heights (Scaffolding, Ladders, etc.) | | ■ Ensure compliance with applicable subparts of 29 CFR 1910.<br>■ Identify special PPE needs (e.g., lanyards, safety nets, etc.)<br>■ Other: |
| Noise | | ■ Establish noise level standards for on-site equipment/operations.<br>■ Inform personnel of hearing protection requirements (Section 7).<br>■ Define site-specific requirements for noise monitoring (Section 8).<br>■ Other: |
| Overhead Obstructions | | ■ Wear hard hat.<br>■ Other: Hard hats required in the vicinity of heavy equipment. |
| Power Tools | | ■ Ensure compliance with 29 CFR 1910 Subpart P.<br>■ Other: |
| Sunburn | 1-5 | ■ Apply sunscreen. |

| Hazard | Task Number | Hazard Control Measures |
|---|---|---|
| | | ■ Wear hats/caps and long sleeves.<br>■ Other: |
| Utility Lines | | ■ Identify/locate existing utilities prior to work.<br>■ Ensure that overhead utility lines are at least 25 feet away from project activities.<br>■ Contact utilities to confirm locations, as necessary.<br>■ Other: |
| Weather Extremes | 1-5 | ■ Potential hazards: Cold, wind, snow<br>■ Establish site-specific contingencies for severe weather situations.<br>■ Provide for frequent weather broadcasts.<br>■ Weatherize safety gear, as necessary (e.g., ensure eye wash units cannot freeze, etc.).<br>■ Identify special PPE (Section 7) needs.<br>■ Discontinue work during severe weather.<br>■ Other: |
| Other: Water Safety | 1-5 | ■ If the creek is in flood stage, PFDs must be worn by all persons wading in water and by all land-based personnel working within 10-feet of the shore.<br>■ Do NOT wade in flowing water when the product of depth (in feet) and velocity (in feet per second) equals 12 or greater. Application of this rule varies among individuals according to their weight and stature, and to the condition of the streambed. |

## 6.2 CHEMICAL HAZARD EVALUATION AND CONTROL

### 6.2.1 Chemical Hazard Evaluation

Potential chemical hazards are described by task number in Table 6-1. Hazard Evaluation Sheets for major known contaminants are attached at the end of this plan.

### 6.2.2 Chemical Hazard Control

An appropriate combination of engineering/administrative controls, work practices, and PPE shall be used to reduce and maintain employee exposures to a level at or below published exposure levels (see Section 6.2.1).

Applicable Engineering/Administrative Control Measures: Support zones will be located upwind/upgradient of contaminated areas.

PPE: See Section 7.

## 6.3 RADIOLOGICAL HAZARD EVALUATION AND CONTROL

### 6.3.1 Radiological Hazard Evaluation

Potential radiological hazards are described below by task number. Hazard Evaluation Sheets for major known contaminants are attached at the end of this plan.

| Task Number | Radionuclide | DAC ($\mu$Ci/ml) | Route(s) of Exposure | Major Radiation(s) | Energy(s) (MeV) | Half-Life |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

### 6.3.2 Radiological Hazard Control

Engineering/administrative controls and work practices shall be instituted to reduce and maintain employee exposures to a level at or below the permissible exposure/dose limits (see sections 4.2.3 and 6.3.1). Whenever engineering/administrative controls and work practices are not feasible or effective, any reasonable combination of engineering/administrative controls, work practices, and PPE shall be used to reduce and maintain employee exposures to a level at or below permissible exposure/dose limits.

Applicable Engineering/Administrative Control Measures: Radiological hazards are not anticipated.

PPE: See Section 7.

**TABLE 6-1**

**CHEMICAL HAZARD EVALUATION**

| Task Number | Compound | Exposure Limits (TWA) | | | Dermal Hazard (Y/N) | Route(s) of Exposure | Acute Symptoms | Odor Threshold/ Description | FID/PID | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PEL | REL | TLV | | | | | Relative Response | Ioniz. Poten. (eV) |
| 1-5 | Arsenic * | 0.01 $mg/m^3$ [TWA] | 0.002 $mg/m^3$ [15 min, ceiling] | 0.01 $mg/m^3$ | Y | Inhalation, skin absorption, ingestion, skin and/or eye contact | Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin | Silver-grey or tin-white, brittle, odorless solid. | NA | NA |
| 1-5 | Copper | 1 $mg/m^3$ [TWA] | 1 $mg/m^3$ [TWA] | 1 $mg/m^3$ | Y | inhalation, ingestion, skin and/or eye contact | irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis | Reddish, lustrous, malleable, odorless solid. | NA | NA |
| 1-5 | Lead | TWA 0.050 $mg/m^3$ | TWA (8-hour) 0.050 $mg/m^3$ | TWA 0.050 $mg/m^3$ | Y | inhalation, ingestion, skin and/or eye contact | Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension | A heavy, ductile, soft, gray solid. | NA | NA |
| 1-5 | Mercury | Vapor: 0.1 $mg/m^3$ | Vapor: 0.05 $mg/m^3$ [TWA]<br>0.1 $mg/m^3$ [ceiling] | TWA 0.025 $mg/m^3$ | Y | Inhalation, skin absorption, ingestion, skin and/or eye contact | Irritation eyes, skin; cough, chest pain, breathing difficulty, bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude; stomatitis, salivation; gastrointestinal disturbance | Silver-white, heavy, odorless liquid. | NA | unknown |

Note: Use an asterisk (*) to indicate known or suspected carcinogens.
$mg/m^3$ = milligrams per cubic meter

## 7. LEVEL OF PROTECTION AND PERSONAL PROTECTIVE EQUIPMENT

### 7.1 LEVEL OF PROTECTION

The following levels of protection (LOPs) have been selected for each work task based on an evaluation of the potential or known hazards, the routes of potential hazard, and the performance specifications of the PPE. On-site monitoring results and other information obtained from on-site activities will be used to modify these LOPs and the PPE, as necessary, to ensure sufficient personnel protection. The authorized LOP and PPE shall only be changed with the approval of the regional safety coordinator or designee. Level A is not included below because Level A activities, which are performed infrequently, will require special planning and addenda to this SHASP.

| Task Number | B | C | D | Modifications Allowed |
|---|---|---|---|---|
| 1 | | | X | |
| 2 | | | X | |
| 3 | | | X | |
| 4 | | | X | |
| 5 | | | X | |

Note: Use "X" for initial levels of protection. Use "(X)" to indicate levels of protection that may be used as site conditions warrant.

### 7.2 PERSONAL PROTECTIVE EQUIPMENT

The PPE selected for each task is indicated below. E & E's PPE program complies with 29 CFR 1910.120 and 29 CFR 1910 Subpart I and is described in detail in the CHSP. Refer to 29 CFR 1910 for the minimum PPE required for each LOP.

| PPE | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Full-face APR | | | | | |
| PAPR | | | | | |
| Cartridges: | | | | | |
| P100 and Mersorb | | | | | |
| GMC-P100 | | | | | |
| GME-P100 | | | | | |
| Other: | | | | | |
| Positive-pressure, full-face SCBA | | | | | |
| Spare air tanks (Grade D air) | | | | | |
| Positive-pressure, full-face, supplied-air system | | | | | |
| Cascade system (Grade D air) | | | | | |
| Manifold system | | | | | |
| 5-Minute escape mask | | | | | |

| PPE | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Safety glasses | (X) | (X) | (X) | | |
| Monogoggles | | | | | |
| Coveralls/clothing | | | | | |
| Protective clothing: | | | | | |
| Tyvek | | | | | |
| Saranex | | | | | |
| Other: | | | | | |
| Splash apron | | | | | |
| Inner gloves: | | | | | |
| Cotton | | | | | |
| Nitrile | X | X | X | X | |
| Latex | | | | | |
| Other: | | | | | |
| Outer gloves: | | | | | |
| Viton | | | | | |
| Rubber | | | | | |
| Neoprene | | | | | |
| Nitrile | | | | | |
| Other: | | | | | |
| Work gloves | | | | | |
| Safety boots (as per ANSI Z41) | X | X | X | X | X |
| Neoprene safety boots (as per ANSI Z41) | | | | | |
| Boot covers (type: ________________________________________) | | | | | |
| Hearing protection (type: __________________________________) | | | | | |
| Hard hat – required when in the vicinity of heavy equipment in operation | | | | | |
| Face shield | | | | | |
| Other: Personal Flotation Device | X | X | X | X | |
| Other: | | | | | |

## 8. HEALTH AND SAFETY MONITORING

Health and safety monitoring will be conducted to ensure proper selection of engineering/administrative controls, work practices, and/or PPE so that employees are not exposed to hazardous substances at levels that exceed permissible exposure/dose limits or published exposure levels. Health and safety monitoring will be conducted using the instruments, frequency, and action levels described in Table 8-1. Health and safety monitoring instruments shall have been appropriately calibrated and/or performance-checked prior to use.

## 9. DECONTAMINATION PROCEDURES

All equipment, materials, and personnel will be evaluated for contamination upon leaving the exclusion area. Equipment and materials will be decontaminated and/or disposed and personnel will be decontaminated, as necessary. Decontamination will be performed in the contamination reduction area or any designated area such that the exposure of uncontaminated employees, equipment, and materials will be minimized. Specific procedures are described below.

Equipment/Material Decontamination Procedures (specified by work plan): Any non-disposable sampling equipment will be washed in an alconox-water solution and double rinsed. Equipment will be wiped clean of dust and particulates prior to leaving the site.

Ventilation: All decontamination procedures will be conducted in a well-ventilated area.

Personnel Decontamination Procedures: Remove and dispose of PPE. Wash hands prior to taking breaks, such as lunch, and prior to leaving the site.

PPE Requirements for Personnel Performing Decontamination: Level D

Personnel Decontamination in General: Following appropriate decontamination procedures, all field personnel will wash their hands and face with soap and potable water. Personnel should shower at the end of each work shift.

Disposition of Disposable PPE: Used PPE and disposable sampling equipment will be double bagged in plastic trash bags and disposed of in a municipal refuse dumpster. These wastes are not considered hazardous and can be sent to a municipal landfill. Any PPE or dedicated equipment that is to be disposed of that can still be reused will be rendered inoperable before disposal.

Disposition of Decontamination Wastes (e.g., dry wastes, decontamination fluids, etc.): Decontamination fluids will consist of water with residual contaminants and/or non-phosphate detergent. These fluids will be allowed to infiltrate on-site well away from all surface water bodies or will be left at the site to evaporate.

**TABLE 8-1**

**HEALTH AND SAFETY MONITORING**

| Instrument | Task Number | Contaminant(s) | Monitoring Location | Monitoring Frequency | Action Levels[a] | |
|---|---|---|---|---|---|---|
| ☐ PID<br>(e.g., RAE mini RAE)<br>☐ FID<br>(e.g., OVA 128-)<br>☐ TVA 1000 or MultiRAE | | | | | **Unknown Vapors**<br>Background to 1 ppm above background: Level D<br>1 to 5 ppm above background: Level C<br>5 to 500 ppm above background: Level B<br>>500 ppm above background: Level A | **Contaminant-Specific** |
| Oxygen<br>Meter/Explosimeter<br>☐ Multi RAE or VRAE | | | | | **Oxygen**<br><19.5% or >22.0%: Evacuate area; eliminate ignition sources; reassess conditions.<br>19.5 to 22.0%: Continue work in accordance with action levels for other instruments. | **Explosivity**<br>≤10% LEL: Continue work in accordance with action levels for other instruments; monitor continuously for combustible atmospheres.<br>>10% LEL: Evacuate area; eliminate ignition sources; reassess conditions. |
| Radiation Alert Monitor (Rad-mini or RAM-4) | | | | | <0.1 mR/hr: Continue work in accordance with action levels for other instruments.<br>≥0.1 mR/hr: Evacuate area; reassess work plan and contact radiation safety specialist. | |
| Mini-Ram Particulate Monitors (Personal Data Ram and/or Data Ram) | | | | | **General/Unknown**<br>Evaluate health and safety measures when dust levels exceed 2.5 milligrams per cubic meter. If dust levels exceed 5 $mg/m^3$, cease work until dust levels decrease or don respirator. | **Contaminant-Specific** |
| $HCN/H_2S$ (Monitox) | | | | | ≥4 ppm: Leave area and consult with SSO. | |
| Draeger Colorimetric Tubes | | | | | **Tube** | **Action Level** **Action** |

**TABLE 8-1**

**HEALTH AND SAFETY MONITORING**

| Instrument | Task Number | Contaminant(s) | Monitoring Location | Monitoring Frequency | Action Levels[a] |
|---|---|---|---|---|---|
| Air Monitor/Sampler<br>Type: ________________<br>Sampling medium: ______ | | | | | **Action Level** **Action** |
| Personal Sampling Pump<br>Type: ________________<br>Sampling medium:<br>______________________ | | | | | **Action Level** **Action** |
| Micro R Meter | 1-3 | Gamma Radiation | Throughout site | Initial walkthrough | <2 mR/hr: Continue work in accordance with action levels for other instruments.<br>2 to 5 mR/hr: In conjunction with a radiation safety specialist, continue work and perform stay-time calculations to ensure compliance with dose limits and ALARA policy.<br>>5 mR/hr: Evacuate area to reassess work plan and evaluate options to maintain personnel exposures ALARA and within dose limits. |
| Ion Chamber | | | | | See micro R meter action levels above. |
| Radiation Survey Ratemeter/Scaler with External Detector(s) | | | | | **Detector** **Action Level** **Action** |
| Noise Dosimeter<br>(Sound Level Meter) | | | | | ≤85 decibels as measured using the A-weighed network (dBa): Use hearing protection if exposure will be sustained throughout work shift.<br>>85 dBA: Use hearing protection.<br>>120 dBA: Leave area and consult with safety personnel. |
| Other: | | | | | |

## 10. EMERGENCY RESPONSE

This section contains additional information pertaining to on-site emergency response and does not duplicate pertinent emergency response information contained in earlier sections of this plan (e.g., site layout, monitoring equipment, etc.). Emergency response procedures will be rehearsed regularly, as applicable, during project activities.

### 10.1 EMERGENCY RESPONSIBILITIES

All Personnel: All personnel shall be alert to the possibility of an on-site emergency; report potential or actual emergency situations to the team leader and SSO; and notify appropriate emergency resources, as necessary.

Team Leader: The team leader will determine the emergency actions to be performed by E & E personnel and will direct these actions. The team leader also will ensure that applicable incidents are reported to appropriate E & E and client project personnel and government agencies.

SSO: The SSO will recommend health/safety and protective measures appropriate to the emergency.

Other:

### 10.2 LOCAL AND SITE RESOURCES (including phone numbers)

Ambulance: 911

Hospital: Fairchild Medical Center, 444 Bruce Street, Yreka, CA 96097 (530) 842-4121

Directions to Hospital (map attached at the end of this plan): Head southeast on Indian Creek Road. In 4.8 miles turns left onto Jacobs Way. In 0.4 miles turn left onto CA-96 E. Continue for 61.2 miles on CA-96 E then turn right onto CA263 S and continue for 8.1 miles. Continue onto Main Street and make a U-turn at W Howard Street. Arrive at Fairchild Medical Center.

Poison Control: California Poison Control System – San Francisco Division, UCSF Box 1369, San Francisco, CA 94143 (800) 222-1222

Police Department: 911 or Yreka Police Department, 412 West Miner Street, Yreka CA (530) 841-2300

Fire Department: 911

Client Contact: Chris Weden, EPA OSC (415) 971-6962

Site Contact: Chris Weden, EPA OSC (415) 971-6962

On-Site Telephone Number: To be determined.

Cellular Telephone Number: To be determined.

Radios Available: None.

Other:

## 10.3 E & E EMERGENCY CONTACTS

| | |
|---|---|
| E & E Emergency Operations Center (24 Hours): | 716-684-8060 |
| Corporate Health and Safety Director, Dr. Paul Jonmaire: | 716-684-8060 (office)<br>716-655-1260 (home) |
| Regional Office Contact: Cindy McLeod | 510-893-6700 (office)<br>415-238-3379 (cell)<br>510-654-6250 (home) |
| Other: Sara Dwight | 510-893-6700 (office)<br>415-264-8246 (cell) |
| a. E & E Emergency Response Center: | 716-684-8060 |
| b. Corporate Health and Safety Director, Dr. Paul Jonmaire: | 716-684-8060 (office)<br>716-655-1260 (home) |
| c. Assistant Corporate Safety Director, Tom Siener, CIH: | 716-684-8060 (office)<br>716-662-4740 (home)<br>716-597-5868 (Cell) |

## 10.4 OTHER EMERGENCY RESPONSE PROCEDURES

On-Site Evacuation Signal/Alarm (must be audible and perceptible above ambient noise and light levels): 2 long blasts of vehicle horn.

On-Site Assembly Area: To be determined once on-site

Emergency Egress Route to Get Off Site: To be determined once on-site.

Off-Site Assembly Area: To be determined

Preferred Means of Reporting Emergencies: Call 911, notify E&E personnel and project manager, notify EPA OSC.

Site Security and Control: In an emergency situation, personnel will attempt to secure the affected area and control site access.

Spill Control Procedures: Spill response materials will be available onsite. Spills will be attended to and cleaned up as soon as possible using adsorbents, excavation, or other means.

Emergency Decontamination Procedures: Remove PPE.

PPE: Personnel will don appropriate PPE when responding to an emergency situation. The SSO and Section 7 of this plan will provide guidance regarding appropriate PPE.

Emergency Equipment: Appropriate emergency equipment is listed in Attachment 1. Adequate supplies of this equipment shall be maintained in the support area or other approved work location.

Incident Reporting Procedures: Notify authorities as appropriate. Notify E&E Regional Safety Coordinator as soon as possible and prepare an Incident /Exposure Report.

**ATTACHMENT 1**

**EQUIPMENT/SUPPLIES CHECKLIST**

| | No. |
|---|---|
| **INSTRUMENTATION** | |
| FID | |
| Thermal desorber | |
| $O_2$/explosimeter w/cal. Kit | |
| Photovac tip | |
| PID (probe: __________eV) | |
| Magnetometer | |
| Pipe locator | |
| Weather station | |
| Draeger tube kit (tubes: _____________________) | |
| Brunton compass | |
| Real-time cyanide monitor | |
| Real-time $H_2S$ monitor | |
| Heat stress monitor | |
| Noise equipment | |
| Personal sampling pumps and supplies | |
| MiniRam dust monitor | |
| Sample stands for PDR and air sampling | |
| Mercury monitor - Lumex | |
| Mercury monitor – Lumex soil attachment | |
| Innov-X | |
| GPS | X |
| Spare batteries (type: _______________________) | |
| | |
| **RADIATION EQUIPMENT/SUPPLIES** | |
| Documentation forms | |
| Portable ratemeter | |
| Scaler/ratemeter | |
| 1" NaI gamma probe | |
| 2" NaI gamma probe | |
| ZnS alpha probe | |
| GM pancake probe | |
| Tungsten-shielded GM probe | |
| Micro R meter | |
| Ion chamber | |
| Alert monitor | |

| | No. |
|---|---|
| Pocket dosimeter | |
| Dosimeter charger | |
| Radiation warning tape | |
| Radiation decon supplies | |
| Spare batteries (type: _______________________) | |
| TLD Badges | X |
| | |
| **SAMPLING EQUIPMENT** | |
| 8-oz. jars | X |
| Half-gallon bottles | X |
| VOA bottles | |
| String | |
| Hand bailers | X |
| Thieving rods with bulbs | |
| Disposable Sampling Scoops | X |
| Knives | |
| Plastic bags | X |
| Sample cups (XRF) | |
| Coffee filters | |
| Sample labels | X |
| Mortar/Pestle | |
| Mylar film | |
| | |
| | |
| | |
| | |
| | |
| **MISCELLANEOUS** | |
| Pump | |
| Surveyor's tape | X |
| 100' Fiberglass tape | |
| 300' Nylon rope | |
| Nylon string | |
| Surveying/Sampling flags | |
| Spray Paint | |
| Camera | X |

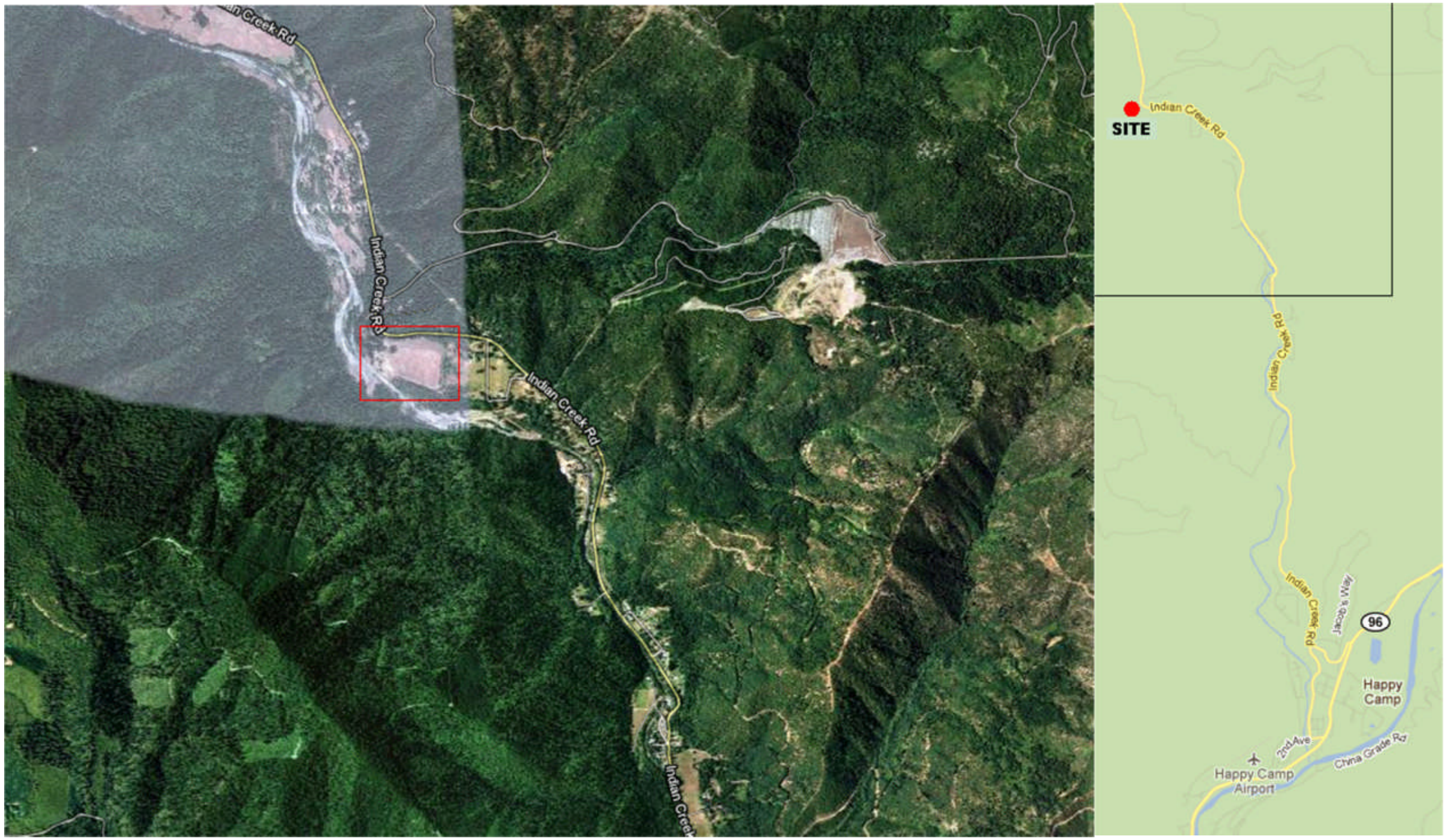
| | No. |
|---|---|
| Film | |
| Bung wrench | |
| Soil auger | X |
| Pick | |
| Shovel | X |
| Catalytic heater | |
| Propane gas | |
| Banner tape | |
| Surveying meter stick | |
| Chaining pins and ring | |
| Logbooks (__1__ large, _____ small) | X |
| Required MSDSs | |
| Intrinsically safe flashlight | X |
| Potable water | X |
| Gatorade or equivalent | X |
| Tables | |
| Chairs | |
| Weather radio | |
| Two-way radios | |
| Binoculars | |
| Megaphone | |
| Cooling vest | |
| Sunscreen | X |
| | |
| **EMERGENCY EQUIPMENT** | |
| First aid kit | X |
| Stretcher | |
| Portable eye wash | |
| Blood pressure monitor | |
| Fire blanket | |
| Fire extinguisher | |
| Thermometer (medical) | |
| Spill kit | |
| Personal Flotation Device | X |
| **DECONTAMINATION EQUIPMENT** | |
| Wash tubs | |
| Buckets | X |
| Scrub brushes | X |

| | No. |
|---|---|
| Pressurized sprayer | |
| Spray bottle | X |
| Detergent (type: Alconox ____________________) | X |
| Solvent (type: ____________________________) | |
| Plastic sheeting | |
| Tarps and poles | |
| Trash bags | X |
| Trash cans | |
| Masking tape | |
| Duct tape | X |
| Paper towels | X |
| Step ladders | |
| Distilled water | X |
| Deionized water | |
| | |
| **SHIPPING EQUIPMENT** | |
| Coolers | X |
| Paint cans with lids, 7 clips each | |
| Vermiculite | |
| Shipping labels | X |
| DOT labels: | |
| "Up" | |
| "Danger" | |
| "Inside Container Complies ..." | |
| Hazard Group | |
| Strapping tape | |
| Box cutter | |
| Custody seals | |
| Chain-of-custody forms | X |
| Express shipment forms | |
| Clear packing tape | X |
| Packing tape dispenser | |
| Permanent markers – thin | X |
| Permanent markers - thick | X |
| Ballpoint pens | X |
| Cable ties | X |
| | |
| | |

| | **No.** |
|---|---|
| **PPE** | |
| Tyvek L | |
| Tyvek XL | |
| Tyvek XXL | |
| Safety Vest | X |
| MSA Respirator | |
| MSA Cartridges – Combo | |
| Respirator wipes | |
| Hard Hat | |
| Steel Toed Boots | X |
| Safety glasses/sunglasses | X |
| Nitrile gloves – M | X |
| Nitrile gloves –X L | X |
| Latex Booties | |
| Waders | X |
| Personal Flotation Devices | X |

Project # 002693.2151.01RA
TDD# TO-02-09-11-08-0001

Source: Google Maps

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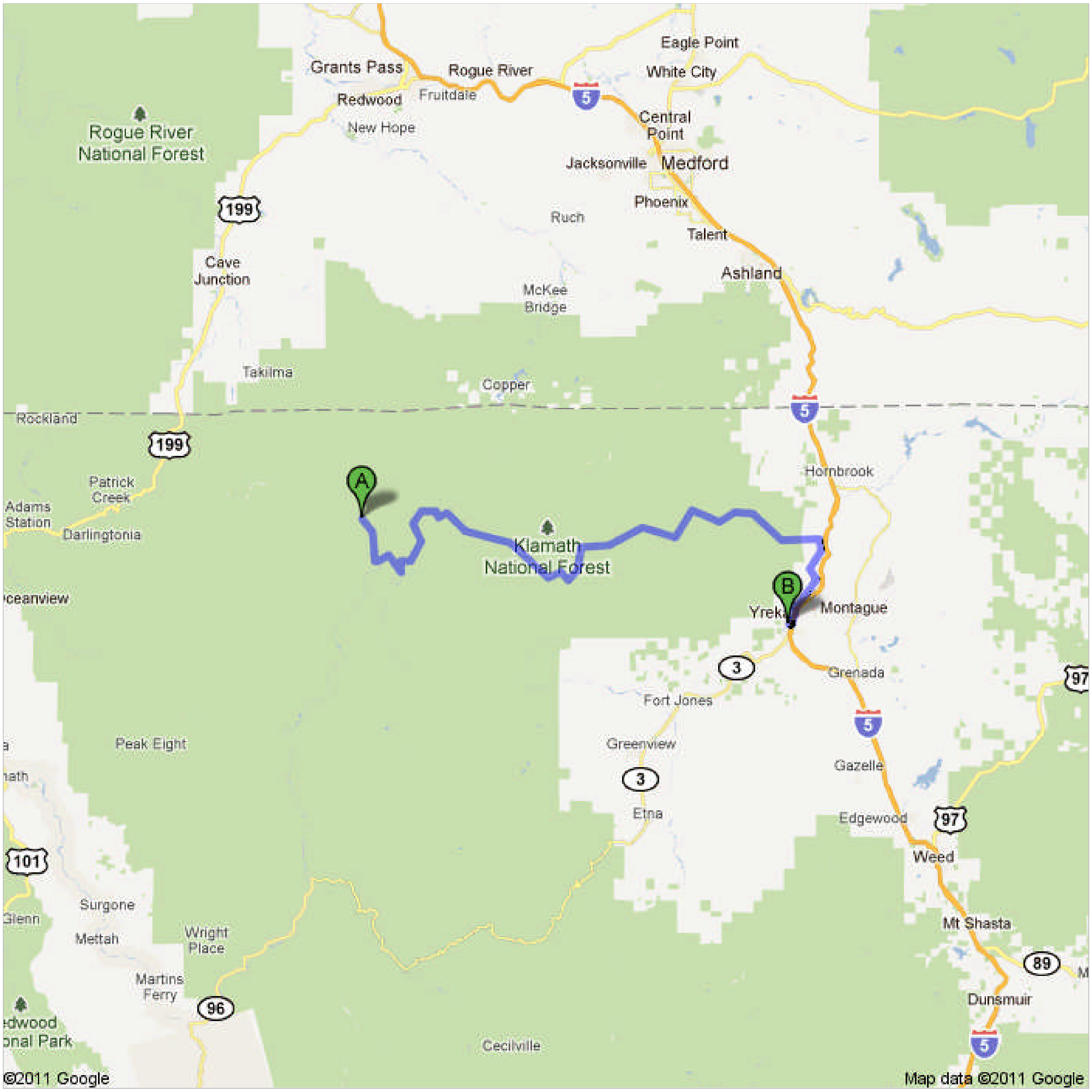
# Site Vicinity Map
# Grey Eagle Mine
### Siskiyou County, California

Google maps

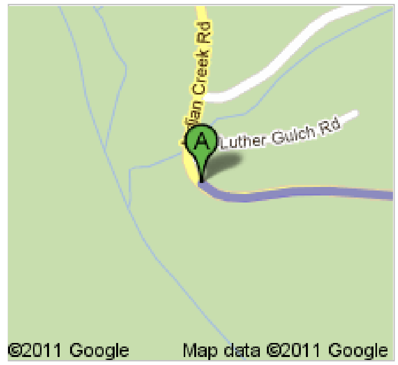
**Directions to Fairchild Medical Center**
Yreka, California - (530) 842-4121
**76.4 mi** – about **1 hour 47 mins**





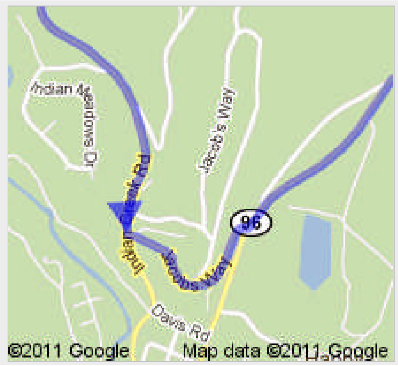
Indian Creek Rd

1. Head **southeast** on **Indian Creek Rd**
About 8 mins




go 4.7 mi
total 4.7 mi

2. Turn left onto **Jacobs Way**
About 1 min

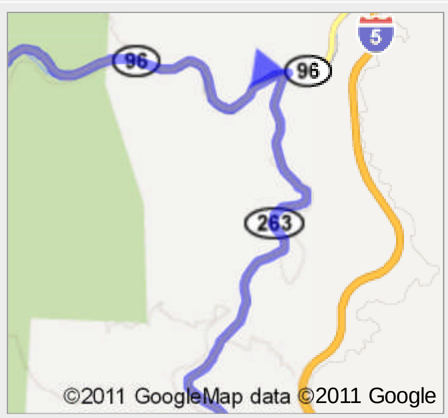



go 0.4 mi
total 5.2 mi

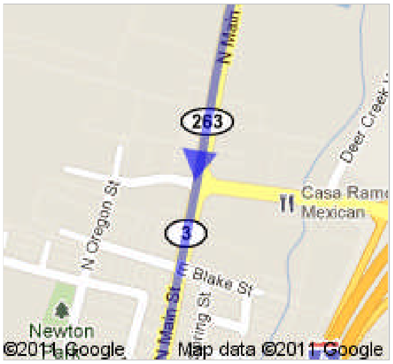
3. Turn left onto **CA-96 E**
About 1 hour 23 mins


go 61.2 mi
total 66.4 mi

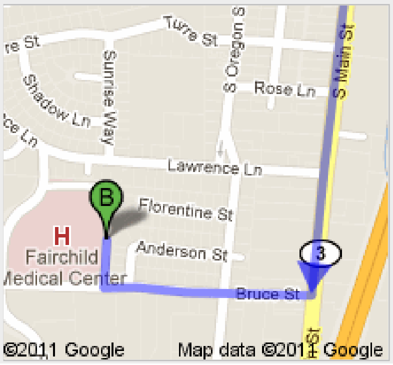
4. Turn right onto **CA-263 S**
About 10 mins




go 8.1 mi
total 74.5 mi

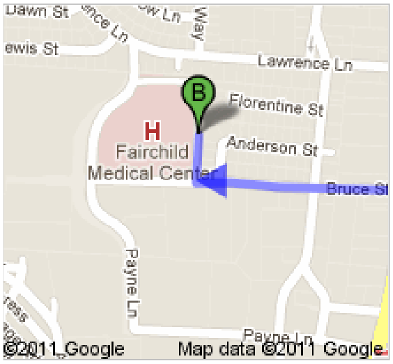



6. Turn right onto **Bruce St**
About 1 min




go 0.3 mi
total 76.3 mi

7. Turn right
Destination will be on the left




go 318 ft
total 76.4 mi

**Fairchild Medical Center**
Yreka, California - (530) 842-4121

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Map data ©2011 Google

Directions weren't right? Please find your route on maps.google.com and click "Report a problem" at the bottom left.

# C

# Standard Operating Procedures

| | |
|---|---|
| Title: | SURFACE WATER SAMPLING |
| Category: | ENV 3.12 |
| Revised: | March 1998 |

STANDARD OPERATING PROCEDURE

# SURFACE WATER SAMPLING



**ecology and environment, inc.**
368 Pleasant View Drive / Lancaster, New York 14086 / (716) 684-8060

| | | | |
|---|---|---|---|
| **TITLE:** | SURFACE WATER SAMPLING | | |
| **CATEGORY:** | ENV 3.12 | **REVISED:** | March 1998 |

# TABLE OF CONTENTS

# 1. Introduction

This Standard Operating Procedure (SOP) outlines recommended procedures and equipment for the collection of representative liquid samples (aqueous and nonaqueous) from streams, rivers, lakes, ponds, lagoons, and surface impoundments both at the surface and at various depths in the water column. This SOP does not pertain to the collection of groundwater samples.

# 2. Method Summary

Sampling situations vary widely and therefore, no universal sampling procedure can be recommended. A sampling plan must be completed before any sampling operation is attempted. The sampling plan should include objectives of the study, the number and type of samples required to meet these objectives, and procedures to collect these samples based on site characteristics.

The sampling of both aqueous and nonaqueous liquids from the above-mentioned sources is generally accomplished through the use of one of the following:

- Kemmerer bottle,
- Bacon bomb,
- Dip sampler, or
- Direct method.

These sampling techniques will allow for the collection of representative samples from the majority of surface water types and impoundments encountered.

# 3. Potential Problems

There are two primary potential problems associated with surface water sampling: cross-contamination of samples, and improper sample collection.

Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and bottles. If this is not possible or practical, then decontamination of sampling equipment is necessary. See E & E's SOP on *Equipment Decontamination* (ENV 3.15).

Improper sample collection can involve using contaminated equipment, disturbance of stream or impoundment substrate, and sampling in a disturbed area such as that caused by a boat wake. Following proper decontamination procedures and minimizing disturbance of the sample site will minimize or eliminate these problems.

# 4. Equipment

Equipment needed for collecting surface water samples includes:

- Kemmerer bottle,
- Bacon bomb,
- Dip sampler,
- Line and messengers,
- Sample bottles, preservative, ziploc bags, ice, coolers,
- Chain-of-custody seals and forms, field data sheets,
- Decontamination equipment,
- Protective clothing,
- Maps/plot plan,
- Safety equipment,
- Compass,
- Tape measure,
- Survey stakes, flags, or buoys and anchors,
- Camera and film,
- Logbook, and
- Sample bottle labels.

# 5. Reagents

Reagents are commonly used to preserve samples and to decontaminate sampling equipment. Appropriate preservation and decontamination procedures should be selected prior to field sampling.

Preservatives commonly used include:

- Nitric acid ($HNO_3$) for metals analyses,
- Sodium hydroxide (NaOH) for cyanide analysis,
- Sulfuric acid ($H_2SO_4$) for TRPH analysis, and
- Hydrochloric acid (HCl) for VOC analysis.

Decontamination reagents include:

- Nitric acid ($HNO_3$),
- Acetone, and
- Deionized or distilled water.

# 6. Health and Safety

Personal safety is always the most important factor in any sampling operation. Sampling under unknown conditions should always be considered worst case, necessitating the selection of appropriate personal protection.

When sampling lagoons or surface impoundments containing known or suspected hazardous substances, adequate precautions must be taken to ensure the safety of sampling personnel. The sampling team member collecting the sample should not get too close to the edge of the impoundment, where bank failure may cause him/her to lose their balance. The person performing the sampling should be on a lifeline and wearing adequate protective equipment.

When conducting sampling from a boat in an impoundment or flowing waters, appropriate boating safety procedures will be followed.

# 7. Procedures

## 7.1 Sampling Considerations

### 7.1.1 Preparation

Prior to the initiation of any sampling operation, the immediate area should be checked for radioactivity, volatile organic compounds (VOCs), photoionization potential, airborne dust, and explosivity, as required by the Site Safety Plan. The following steps should then be taken:

- Determine the extent of the sampling effort, the sampling methods to be employed, and the equipment and supplies needed;

- Obtain necessary sampling and monitoring equipment;
- Decontaminate or preclean equipment, and ensure that it is in working order;
- Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate; and
- Use stakes, flags, or buoys and anchors to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

### 7.1.2 Representative Samples

In order to collect a representative sample, the hydrology and morphology of a stream or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths. Additional information can be found in the references listed in Section 12.

Generally, the deciding factors in the selection of a sampling device for surface water sampling are:

- The depth and flow of surface water body,
- Location from where the sample will be collected, and
- The depth at which the sample(s) is to be collected.

### 7.1.3 Sampler Composition

The sampling device must be constructed of the appropriate materials. Samplers constructed of glass, stainless steel, PVC, or PFTE (teflon) should be used, depending on the types of analyses to be performed (i.e., samples to be analyzed for metals should not be collected in metallic containers).

## 7.2 Sample Collection

### 7.2.1 Kemmerer Bottle

A Kemmerer bottle may be used in most situations where site access is from a boat or structure such as a bridge or pier, and where samples at depth are required. Sampling procedures are as follows:

- Using a properly decontaminated Kemmerer bottle, set the sampling device so that the sampling end pieces are pulled away from the sampling tube, allowing the substance to pass through this tube;

- Slowly lower the preset sampling device to the predetermined depth. Avoid bottom disturbance;

- When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device; and

- Retrieve the sampler. Transfer sample to sample container.

### 7.2.2 Bacon Bomb

This type of sampler may be used in situations similar to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

- Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut; and

- Release the trigger line and retrieve the sampler. Transfer the sample to the sample container by pulling on the trigger.

### 7.2.3 Dip Sampler

A dip sampler is useful for situations in which a sample is to be recovered from an outfall pipe, such as through a storm sewer grating, or along a lagoon bank where direct accessibility is limited. The long handle on such a device allows access from a discrete location. The procedure is as follows:

- Assemble the device in accordance with the manufacturer's instructions,

- Extend the device to the sample location and collect the sample, and

- Retrieve the sampler.

### 7.2.4 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants is a concern.

Using adequate protective clothing (i.e., gloves and hip waders), access the sampling station by appropriate means (wading or boat). For shallow stream stations, collect the sample under the water surface pointing the sample container upstream. The container must also be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake.

## 8. Sample Preservation, Containers, Handling, and Storage

Sample preservation, sample containers, sample handling, and sample storage are critical concerns for many types of analyses. Once the analyses to be performed are determined, E & E's SOP on sample packaging and shipping should be consulted to determine the above parameters. This must be completed prior to field sampling.

Once the samples have been collected, the following procedure should be followed:

- Transfer the sample(s) into suitable and labeled sample containers;
- Preserve the sample, if appropriate;
- Cap and put a custody seal on the container, package appropriately, and place in an iced cooler if required;
- Record all pertinent data in the field logbook and on a field data sheet;
- Complete chain-of-custody record and sample analysis request form;
- Attach custody seals to cooler prior to shipment; and
- Decontaminate all sampling equipment prior to the collection of additional samples.

## 9. Calculations

This procedure does not involve specific calculations.

## 10. Quality Assurance

There are no specific quality assurance (QA) activities that apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on field data sheets or within field or site logbooks;
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer unless otherwise specified in the work plan. Equipment

checkout and calibration activities must occur prior to sampling or operation and must be documented; and

- All deliverables will receive a peer review prior to release.

# 11. Data Validation

The data generated will be reviewed according to the QA considerations listed in Section 9.

# 12. References

U.S. Environmental Protection Agency, 1991, *Compendium of ERT Surface Water and Sediment Sampling Procedures*, Interim Final, OSWER Directive 9360.4-03.

__________, 1984, *Characterization of Hazardous Waste Sites - A Methods Manual: Volume II, Available Sampling Methods*, (2nd ed.), EPA/600/4-84-076.

U.S. Geological Survey, 1977, *National Handbook on Recommended Methods for Water Data Acquisition, Office of Water Data Coordination, Reston, Virginia*.

| | |
|---|---|
| **Title:** | **SOIL SAMPLING** |
| **Category:** | ENV 3.13 |
| **Revised:** | August 1997 |

**STANDARD OPERATING PROCEDURE**

# SOIL SAMPLING



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<u>Appendix</u>

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# 1. Introduction

This document describes the procedures for the collection of representative soil samples. Representative sampling ensures the accurate characterization of site conditions. Analysis of soil samples may determine pollutant concentrations and the accompanying risks to public health, welfare, or the environment.

# 2. Scope

Included in this discussion are procedures for obtaining representative samples, quality assurance/quality control (QA/QC) measures, proper documentation of sampling activities, and recommendations for personnel safety.

# 3. Method Summary

Soil samples may be recovered using a variety of methods and equipment. These are dependent on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type.

Samples of near-surface soils may be easily obtained using a spade, stainless-steel spoon, trowel, or scoop. Sampling at greater depths may be performed using a hand auger; a power auger; or, if a test pit is required, a backhoe.

All sampling devices should be cleaned using pesticide-grade acetone (assuming that acetone is not a target compound) or methanol, then wrapped in clean aluminum foil, and custody sealed for identification. The sampling equipment should remain in this wrapping until it is needed. Each sampler should be used for one sample only. However, dedicated tools may be impractical if there is a large number of soil samples required. In this case, samplers should be cleaned in the field using standard decontamination procedures as outlined in E & E's Standard Operating Procedure (SOP) for Sampling Equipment Decontamination (see ENV 3.15).

# 4. Sample Preservation, Containers, Handling, and Storage

The chemical preservation of solids is not generally recommended. Refrigeration is usually the best approach, supplemented by a minimal holding time.

Soil samples should be handled according to the procedures outlined in E & E's SOP for Sample Packaging (see ENV 3.16).

# 5. Potential Problems

Potential problems with soil sampling include cross-contamination of samples and improper sample collection. Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and bottles. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection is generally the result of the use of contaminated equipment; the disturbance of the matrix, resulting in compaction of the sample; and inadequate homogenization of the sample where required, resulting in variable, nonrepresentative results. Specific advantages and disadvantages of soil sampling equipment are presented in Table 5-1.

**Table 5-1 Soil Sampling Equipment**

| Equipment | Applicability | Advantages and Disadvantages |
|---|---|---|
| Trier | Soft surface soil | Inexpensive; easy to use and decontaminate; difficult to use in stony, dry, or sandy soil. |
| Scoop, trowel, spoon, or spatula | Soft surface soil | Inexpensive; easy to use and decontaminate; trowels with painted surfaces should be avoided. |
| Tulip bulb planter | Soft soil, 0 to 6 inches | Easy to use and decontaminate; uniform diameter and sample volume; preserves soil core (suitable for volatile organic analysis (VOA) and undisturbed sample collection); limited depth capability; not useful for hard soils. |
| Spade or shovel | Medium soil, 0 to 12 inches | Easy to use and decontaminate; inexpensive; can result in sample mixing and loss of volatile organic compounds (VOCs). |
| Vehimeyer soil outfit | Soil, 0 to 10 feet | Difficult to drive into dense or hard material; can be difficult to pull from ground. |
| Soil coring device and auger | Soft soil, 0 to 24 inches | Relatively easy to use; preserves soil core (suitable for VOA and undisturbed sample collection); limited depth capability; can be difficult to decontaminate. |
| Thin-walled tube sampler | Soft soil, 0 to 10 feet | Easy to use; preserves soil core (suitable for VOA and undisturbed sample collection); may be used to help maintain integrity of VOA samples; easy to decontaminate; can be difficult to remove cores from sampler. |
| Split-spoon sampler | Soil, 0 inches to bedrock | Excellent depth range; preserves soil core (suitable for VOA and undisturbed sample collection); acetate sleeve may be used to help maintain integrity of VOA samples; useful for hard soils; often used in conjunction with drill rig for obtaining deep cores. |

**Table 5-1 Soil Sampling Equipment**

| Equipment | Applicability | Advantages and Disadvantages |
|---|---|---|
| Shelby tube sampler | Soft soil, 0 inches to bedrock | Excellent depth range; preserves soil core (suitable for VOA and undisturbed sample collection); tube may be used to ship sample to lab undisturbed; may be used in conjunction with drill rig for obtaining deep cores and for permeability testing; not durable in rocky soils. |
| Laskey sampler | Soil, 0 inches to bedrock | Excellent depth range; preserves soil cores; used in conjunction with drill rig for obtaining deep core; can be difficult to decontaminate. |
| Bucket auger | Soft soil, 3 inches to 10 feet | Easy to use; good depth range; uniform diameter and sample volume; acetate sleeve may be used to help maintain integrity of VOA samples; may disrupt and mix soil horizons greater than 6 inches in thickness. |
| Hand-operated power auger | Soil, 6 inches to 15 feet | Good depth range; generally used in conjunction with bucket auger for sample collection; destroys soil core (unsuitable for VOA and undisturbed sample collection); requires two or more equipment operators; can be difficult to decontaminate; requires gasoline-powered engine (potential for cross-contamination). |
| Continuous-flight auger | Soil, 0 inches to bedrock | Excellent depth range; easy to decontaminate; can be used on all soil samples; results in soil mixing and loss of VOCs. |
| Dutch auger | Designed specifically for wet, fibrous, or rooted soils (e.g., marshes) | |
| Eijkelcamp stoney soil auger | Stoney soils and asphalt | |
| Backhoe | Soil, 0 inches to 10 feet | Good depth range; provides visual indications as to depth of contaminants; allows for recovery of samples at specific depths; can result in loss of VOCs and soil mixing; shoring required at depth. |

Note: Samplers may not be suitable for soils with coarse fragments.
Augers are suitable for soils with limited coarse fragments; only the stoney auger will work well in very gravelly soil.

# 6. Soil Sampling Equipment

## Soil Sampling Equipment List

- Stainless-steel spoon
- Trier
- Scoop
- Trowel

- Spatula
- Stainless-steel tulip bulb planter
- Spade or shovel
- Vehimeyer soil sampler outfit
  - tubes
  - points
  - drive head
  - drop hammer
  - fuller jack and grip
- Soil-coring device
- Thin-walled tube sampler
- Split-spoon sampler
- Shelby tube sampler
- Laskey sampler
- Bucket auger
- Hand-operated power auger
- Continuous-flight auger
- Dutch auger
- Eijkelcamp stoney soil auger
- Backhoe
- Hand auger with replaceable sleeves

## Sampling Support Equipment and Documentation List

- Sampling plan
- Sample location map
- Safety equipment, as specified in the Health and Safety Plan
- Decontamination supplies and equipment, as described in the Work Plan
- Compass
- Tape measure
- Survey stakes or flags
- Camera
- Stainless-steel buckets or bowls
- Sample containers, precleaned (e.g., I-Chem)
- Logbook
- Chain-of-custody forms
- Plastic sheet
- Soil gas probes
- Infiltrometer
- Pounding sleeve
- Extension rods
- T-handle

**Labeling, Packaging, and Shipping Supplies**

- Coolers
- Labels for sample containers and coolers (e.g., "fragile")
- Ice
- Plastic bags for sample containers and ice
- ESC paint cans and clamps for polychlorinated biphenyl sampling
- Vermiculite (only if certified asbestos free) or other absorbent
- Duct and strapping tape
- Federal Express airbills and pouches

## 6.1 Geophysical Equipment

Geophysical techniques can be integrated with field analytical and soil sampling equipment to help define areas of subsurface contamination. For a description of the geophysical techniques and associated applications, refer to E & E's SOP for Surface Geophysical Techniques (see GEO 4.2).

# 7. Reagents

This procedures does not require the use of reagents except for decontamination of equipment, as required. Refer to E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15) and the Site-Specific Work Plan for proper decontamination procedures and appropriate solvents.

# 8. Procedures

## 8.1 Office Preparation

1. The preparation of a Health and Safety Plan is required prior to any sampling. The plan must be approved and signed by the Corporate Health and Safety Officer or his/her designee (i.e., the Regional Safety Coordinator).

2. Prepare a Sampling Plan to meet the data quality objectives of the project in accordance with contract requirements. Review available background information (i.e., topographic maps, soil survey maps, geologic maps, other site reports, etc.) to determine the extent of the sampling effort, the sampling method to be employed, and the type and amounts of equipment and supplies required.

3. Obtain necessary sampling and monitoring equipment (see Section 6), decontaminate or preclean the equipment, and ensure that it is in working order.

4. Contact the delivery service to confirm the ability to ship all equipment and samples. Determine whether shipping restrictions exist.

5. Prepare schedules and coordinate with staff, clients, and regulatory agencies, if appropriate.

## 8.2 Field Preparation

1. Identify local suppliers of sampling expendables (e.g., ice and plastic bags) and overnight delivery services (e.g., Federal Express).

2. Decontaminate or preclean all equipment before soil sampling, as described in E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15), or as deemed necessary.

3. A general site survey should be performed prior to site entry in accordance with the Health and Safety Plan, followed by a site safety meeting.

4. Identify and stake all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations will be utility-cleared by the property owner or field team prior to soil sampling.

## 8.3 Representative Sample Collection

The objective of representative sampling is to ensure that a sample or group of samples adequately reflects site conditions.

### 8.3.1 Sampling Approaches

It is important to select an appropriate sampling approach for accurate characterization of site conditions. Each approach is defined below. Table 8-1 summarizes the following sampling approaches and ranks them from most to least suitable based on the sampling objective.

#### 8.3.1.1 Judgmental Sampling

Judgmental sampling is based on the subjective selection of sampling locations relative to historical site information, on-site investigation (site walk-over), etc. There is no randomization associated with this sampling approach because samples are collected primarily at areas of suspected highest contaminant concentrations. Therefore, any statistical calculations based on the sampling results would be unfairly biased.

**Table 8-1 Representative Sampling Approach Comparison**

| Sampling Objective | Judgmental | Random | Stratified Random | Systematic Grid | Systematic Random | Search | Transect |
|---|---|---|---|---|---|---|---|
| Establish Threat | 1 | 4 | 3 | 2[a] | 3 | 3 | 2 |
| Identify Sources | 1 | 4 | 2 | 2[a] | 3 | 2 | 3 |
| Delineate Extent of Contamination | 4 | 3 | 3 | 1[b] | 1 | 1 | 1 |
| Evaluate Treatment and Disposal Options | 3 | 3 | 1 | 2 | 2 | 4 | 2 |
| Confirm Cleanup | 4 | 1[c] | 3 | 1[b] | 1 | 1 | 1[c] |

1 Preferred approach.
2 Acceptable approach.
3 Moderately acceptable approach.
4 Least acceptable approach.
a Should be used with field analytical screening.
b Preferred only where known trends are present.
c Allows for statistical support of cleanup verification if sampling over entire site.

### 8.3.1.2 Random Sampling

Random sampling involves the arbitrary collection of samples within a defined area. Refer to EPA 1984 and EPA 1989 for a random number table and guidelines on selecting sample coordinates. The arbitrary selection of sample locations requires each sample location to be chosen independently so that results in all locations within the area of concern have an equal chance of being selected. To facilitate statistical probabilities of contaminant concentration, the area of concern must be homogeneous with respect to the parameters being monitored. Thus, the higher the degree of heterogeneity, the less the random sampling approach will reflect site conditions (see Figure 8-1).

### 8.3.1.3 Stratified Random Sampling

Stratified random sampling relies primarily on historical information and prior analytical results to divide the area of concern into smaller sampling areas, or “strata.” Strata can be defined by several factors, including sampling depth, contaminant concentration levels, and contaminant source areas. Sampling locations should be selected within a strata using random selection procedures (see Figure 8-2).

### 8.3.1.4 Systematic Grid Sampling

Systematic grid sampling involves the division of the area of concern into smaller sampling areas using a square or triangular grid. Samples are then collected from the intersections of the grid lines, or “nodes.” The origin and direction for placement of the grid should be selected by using an initial random point. The distance between nodes is dependent upon the size of the area of concern and the number of samples to be collected (see Figure 8-3).

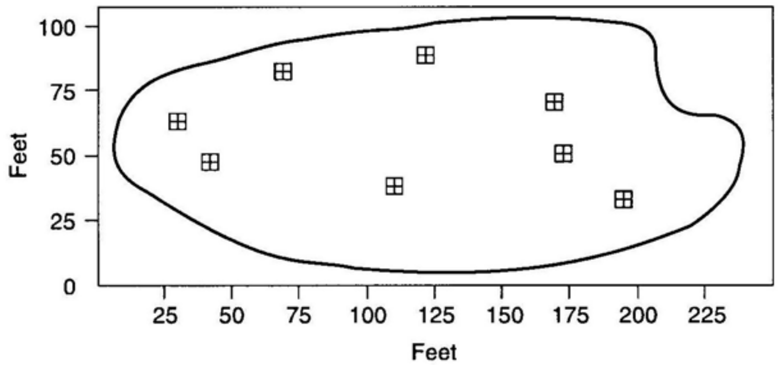



**Figure 8-1 Random Sampling****

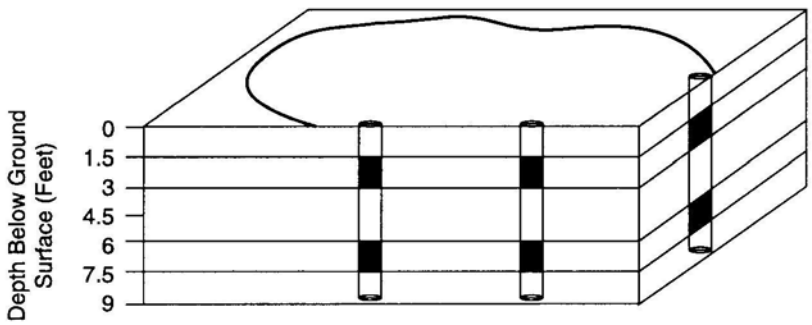



**Figure 8-2 Stratified Random Sampling**

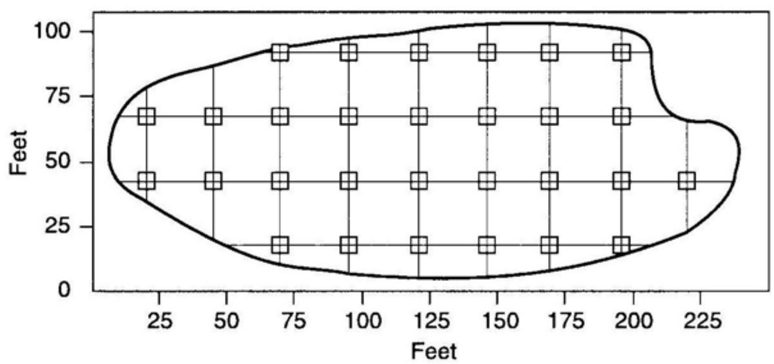
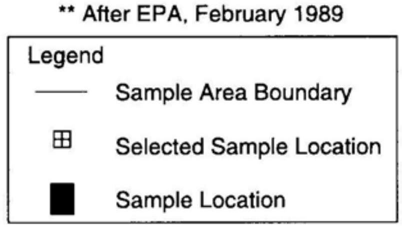



**Figure 8-3 Systematic Grid Sampling****

** After EPA, February 1989



### 8.3.1.5 Systematic Random Sampling

Systematic random sampling involves dividing the area of concern into smaller sampling areas as described in Section 8.3.1.4. Samples are collected within each grid cell using random selection procedures (see Figure 8-4).

### 8.3.1.6 Biased-Search Sampling

Search sampling utilizes a systematic grid or systematic random sampling approach to define areas where contaminants exceed cleanup standards (i.e., hot spots). The distance between the grid lines and number of samples to be collected are dependent upon the acceptable level of error (i.e., the chance of missing a hot spot). This sampling approach requires that assumptions be made regarding the size, shape, and depth of hot spots (see Figure 8-5).

### 8.3.1.7 Transect Sampling

Transect sampling involves establishing one or more transect lines, parallel or nonparallel, across the area of concern. If the lines are parallel, this sampling approach is similar to systematic grid sampling. The advantage of transect sampling over systematic grid sampling is the relative ease of establishing and relocating transect lines as opposed to an entire grid. Samples are collected at regular intervals along the transect line at the surface and/or at a specified depth(s). The distance between the sample locations is determined by the length of the line and the number of samples to be collected (see Figure 8-6).

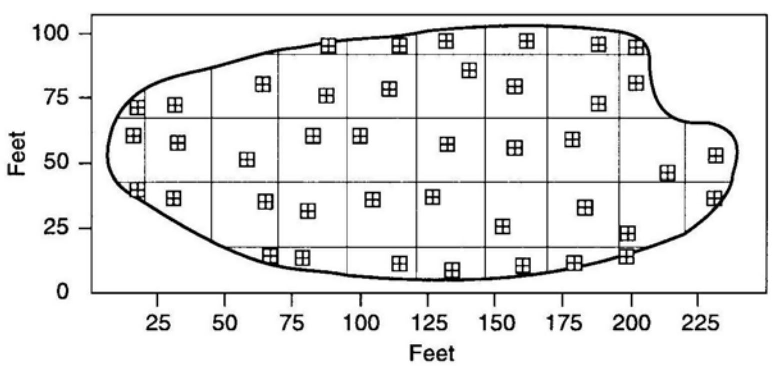



**Figure 8-4 Systematic Random Sampling**

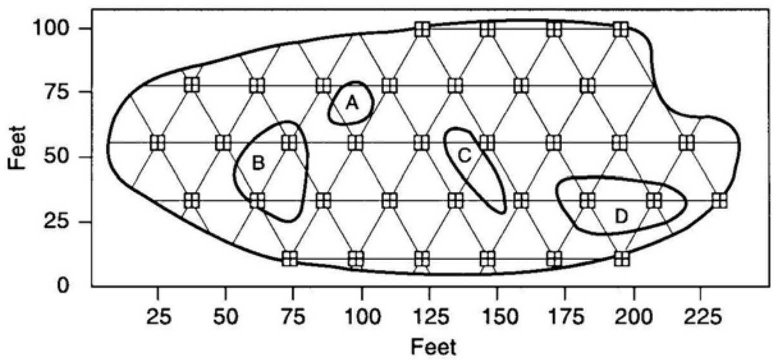



**Figure 8-5 Search Sampling**

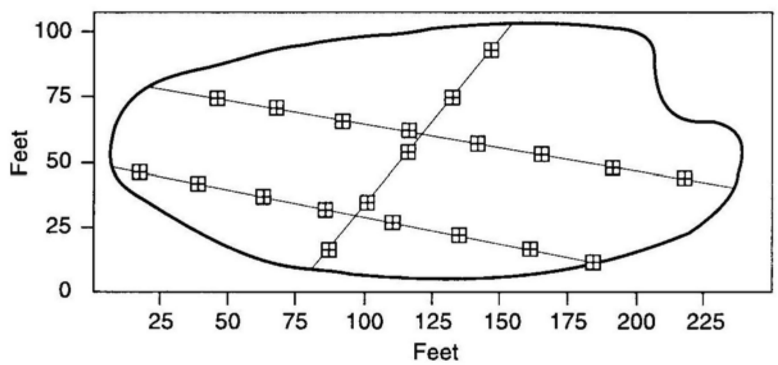
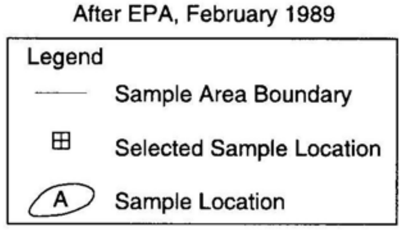



**Figure 8-6 Transect Sampling**

After EPA, February 1989




## 8.3.2 Surface Soil Samples

Collection of samples from near-surface soil can be accomplished with tools such as spades, spoons, shovels, and scoops. The surface material can be removed to the required depth with this equipment; stainless-steel or plastic scoops can then be used to collect the sample.

This method can be used in most soil types, but is limited to sampling near-surface areas. Accurate, representative samples can be collected with this procedure, depending on the care and precision demonstrated by the sampling technician. The use of a flat, pointed mason trowel to cut a block of the desired soil can be helpful when undisturbed profiles are required (e.g., for volatile organic analyses [VOAs]). A stainless-steel scoop, lab spoon, or plastic spoon will suffice in most other applications. Care should be exercised to avoid the use of devices plated with chrome or other materials, as is common with garden implements such as potting trowels.

Soil samples are collected using the following procedure:

1. Carefully remove the top layer of soil to the desired sample depth with a precleaned spade;

2. Using a precleaned, stainless-steel scoop, spoon, trowel, or plastic spoon, remove and discard the thin layer of soil from the area that came into contact with the shovel;

3. Transfer the sample into an appropriate container using a stainless-steel or plastic lab spoon or equivalent. If composite samples are to be collected, place the soil sample in a stainless-steel or plastic bucket and mix thoroughly to obtain a homogeneous sample representative of the entire sampling interval. Place the soil samples into labeled containers. **(Caution: Never composite VOA samples)**;

4. VOA samples should be collected directly from the bottom of the hole before mixing the sample to minimize volatilization of contaminants;

5. Check to ensure that the VOA vial Teflon liner is present in the cap, if required. Fill the VOA vial fully to the top to reduce headspace. Secure the cap tightly. The chemical preservation of solids is generally not recommended. Refrigeration is usually the best approach, supplemented by a minimal holding time;

6. Ensure that a sufficient sample size has been collected for the desired analysis, as specified in the Sampling Plan;

7. Decontaminate equipment between samples according to E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15); and

8. Fill in the hole and replace grass turf, if necessary.

QA/QC samples should be collected as specified, according to the Work Plan.

### 8.3.3 Sampling at Depth with Augers and Thin-Walled Tube Samplers

This system consists of an auger, a series of extensions, a T-handle, and a thin-walled tube. The auger is used to bore a hole to a desired sampling depth and is then withdrawn. The auger tip is then replaced with a tube core sampler, lowered down the borehole, and driven into the soil to the completion depth. The core is then withdrawn and the sample is collected.

Several augers are available, including bucket type, continuous-flight (screw), and post-hole augers. Because they provide a large volume of sample in a short time, bucket types are better for direct sample recovery. When continuous-flight augers are used, the sample can be collected directly off the flights, usually at 5-foot intervals. The continuous-flight augers are satisfactory for use when a composite of the complete soil column is desired. Posthole augers have limited utility for sample collection because they are designed to cut through fibrous, rooted, swampy soil.

The following procedures will be used for collecting soil samples with the hand auger:

1. Attach the auger bit to a drill rod extension, and attach the T-handle to the drill rod.

2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, and litter). It may be advisable to remove the first 3 to 6 inches of surface soil from an area approximately 6 inches in radius around the drilling location.

3. Begin augering, periodically removing and depositing accumulated soils onto a canvas or plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the boring. When sampling directly from the auger, collect the sample after the auger is removed from the boring and proceed to Step 11.

5. A precleaned stainless-steel auger sleeve can also be used to collect a sample. After reaching the desired sampling depth, remove the auger and place the sleeve inside the auger. Collect the sample with the auger. Remove the auger from the boring. The sample will be collected only from the sleeve. The soil from the auger tip should never be used for the sample.

6. Remove the auger tip from the dill rods and replace with a precleaned thin-walled tube sampler. Install the proper cutting tip.

7. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rods to facilitate coring, because the vibrations may cause the boring walls to collapse.

8. Remove the tube sampler and unscrew the drill rods.

9. Remove the cutting tip and core from the device.

10. Discard the top of the core (approximately 1 inch), because this represents material collected before penetration of the layer in question. Place the remaining core into the sample container.

11. If required, ensure that a Teflon liner is present in the cap. Secure the cap tightly onto the sample container. Place the sample bottle in a plastic bag and put on ice to keep the sample at 4°Celsius.

12. Carefully and clearly label the container with the appropriate sample tag, addressing all the categories or parameters listed in E & E's SOP for Sample Packaging and Shipping (see ENV 3.16).

13. Use the chain-of-custody form to document the types and numbers of soil samples collected and logged. Verify that the chain-of-custody form is correctly and completely filled out.

14. Record the time and date of sample collection, as well as a description of the sample, in the field logbook.

15. If another sample is to be collected in the sample hole, but at a greater depth, re-attach the auger bit to the drill and assembly, and follow Steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.

16. Abandon the hole according to applicable regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

17. Decontaminate the sampling equipment per E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15).

### 8.3.4 Sampling at Depth with a Trier

1. Insert the trier into the material to be sampled at a 0° to 45° angle from horizontal. This orientation minimizes the spillage of sample material. Extraction of samples may require tilting of the containers.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure that the slot is facing upward.

4. Transfer the sample into a suitable container with the aid of a spatula and brush.

5. If required, ensure that a Teflon liner is present in the cap. Secure the cap tightly onto the sample container. Samples are handled in accordance with E & E's SOP for Sample Packaging and Shipping (see ENV 3.16).

6. Carefully and clearly label the container with the appropriate sample tag, addressing all the categories or parameters listed in E & E's SOP for Sample Packaging and Shipping (see ENV 3.16).

7. Use the chain-of-custody form to document the types and numbers of soil samples collected and logged.

8. Record the time and date of sample collection as well as a description of the sample and any associated air monitoring measurements in the field logbook.

9. Abandon the hole according to applicable regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

10. Decontaminate sampling equipment per E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15).

### 8.3.5 Sampling at Depth with a Split-Spoon (Barrel) Sampler

The procedure for split-spoon sampling describes the extraction of undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be sampled to give a complete soil column, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extraction.

This sampling device may be used to collect information such as soil density. All work should be performed in accordance with American Society for Testing and Materials (ASTM) D 1586-84, *Penetration Test and Split Barrel Sampling of Soils*.

1. Assemble the sampler by aligning both sides of the barrel and then screwing the bit on the bottom and the heavier head piece on top. Install a retaining cap in the head piece if necessary.

2. Place the sampler in a perpendicular position on the sample material.

3. Using a sledge hammer or well ring, if available, drive the tube. Do not drive past the bottom of the head piece because compression of the sample will result.

4. Record the length of the tube used to penetrate the material being sampled and the number of blows required to obtain this depth.

5. Withdraw the split spoon and open by unscrewing the bit and head. If a split sample is desired, a clean stainless-steel knife should be used to divide the tube contents in half, lengthwise. This sampler is available in 2- and 3.5-inch diameters. The required sample volume may dictate the use of the larger barrel. If needed, stainless-steel or Teflon sleeves can be used inside the split-spoon. If sleeves removed from the split-spoon are capped immediately, volatilization of contaminants can be reduced. When split-spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D 1586-67 (reapproved in 1974).

6. Cap the sample container, place in a double plastic bag, and attach the label and custody seal. Record all pertinent data in the field logbook and complete the sample analysis request form and chain-of-custody record before collecting the next sample.

7. If required, preserve or place the sample on ice.

8. Follow proper decontamination procedures and deliver samples to the laboratory for analysis.

### 8.3.6 Test Pit/Trench Excavation

These relatively large excavations are used to remove sections of soils when detailed examination of soil characteristics (horizontal, structure, color, etc.) is required. It is the least cost-effective sampling method because of the relatively high cost of backhoe operation.

1. Prior to any excavations with a backhoe, it is important to ensure that all sampling locations are clear of utility lines and poles (subsurface as well as above surface).

2. Using the backhoe, a trench is dug to approximately 3 feet in width and approximately 1 foot below the cleared sampling depth. Place removed or excavated soils on canvas or plastic sheets, if necessary. Trenches greater than 4 feet deep must be sloped or protected by a shoring system, as required by Occupational Safety and Health Administration (OSHA) regulations.

3. A shovel is used to remove a 1- to 2-inch layer of soil from the vertical face of the pit where sampling is to be done.

4. Samples are collected using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose soil for sampling. Samples are removed and placed in an appropriate container.

5. If required, ensure that a Teflon liner is present in the cap. Secure the cap tightly onto the sample container. Samples are handled in accordance with E & E's SOP for Sample Packaging and Shipping (see ENV 3.16).

6. Carefully and clearly label the container with the appropriate sample tag, addressing all the categories or parameters listed in E & E's SOP for Sample Packaging and Shipping (see ENV 3.16).

7. Use the chain-of-custody form to document the types and numbers of soil samples collected and logged.

8. Record the time and date of sample collection as well as a description of the sample and any associated air monitoring measurements in the field logbook.

9. Abandon the hole according to applicable state regulations. Generally, excavated holes can simply be backfilled with the removed soil material.

10. Decontaminate sampling equipment, including the backhoe bucket, per E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15).

## 8.4 Sample Preparation

In addition to sampling equipment, representative sample collection includes sample quantity, volume, preservation, and holding time (see Table 8-2). *Sample preparation* refers to all aspects of sample handling after collection. How a sample is prepared can affect its representativeness. For example, homogenizing can result in a loss of volatiles and is therefore inappropriate when volatile contaminants are the concern.

### 8.4.1 Sample Quantity and Volume

The volume and number of samples necessary for site characterization will vary according to the budget, project schedule, and sampling approach.

### 8.4.2 Sample Preservation and Holding Time

Sample preservation and holding times are as discussed in Section 4.

### 8.4.3 Removing Extraneous Material

Discard materials in a sample that are not relevant for site or sample characterization (e.g., glass, rocks, and leaves), because their presence may introduce an error in analytical procedures.

### 8.4.4 Homogenizing Samples

Homogenizing is the mixing of a sample to provide a uniform distribution of the contaminants. Proper homogenization ensures that the containerized samples are representative of the total soil sample collected. All samples to be composited or split should be homogenized after all aliquots have been combined. Do not homogenize samples for volatile compound analysis.

**Table 8-2 Standard Sampling Holding Times, Preservation Methods, and Volume Requirements**

| Protocol Parameter | Holding Time | | Minimum Volume Required | | Container Type | | Preservation | |
|---|---|---|---|---|---|---|---|---|
| | Soil | Water | Soil | Water | Soil | Water | Soil | Water |
| **SW-846** | | | | | | | | |
| VOA[e] | 14 days from date sampled | 14 days from date sampled | 15 g | One 40-mL vial; no air space | Two 40-mL vials; no air space | Two 40-mL vials; no air space | Cool to 4°C (ice in cooler) | Add HC1 until pH <2 and cool to 4° (ice in cooler) |
| Semi-VOA (BNAs)[e] | 14 days to extract from date sampled | 7 days to extract from date sampled | 30 g | 1 L | 8-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| PCBs[d,e] | 14 days to extract from date sampled | 7 days to extract from date sampled | 30 g | 1 L | 4-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Pesticides/PCBs[d,e] | 14 days to extract from date sampled | 7 days to extract from date sampled | 30 g | 1 L | 8-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Metals[c] | 6 months from date sampled | 6 months from date sampled | 10 g | 300 mL | 8-oz. glass jar with Teflon-lined cap | 1-L polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add $HNO_3$ until pH <2 and cool to 4°C (ice in cooler) |
| Cyanide[c] | 14 days from date sampled | 14 days from date sampled | 10 g | 100 mL | 8-oz. glass jar with Teflon-lined cap | 1-L polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add NaOH until pH >12 and cool to 4°C (ice in cooler) |
| Hexavalent chromium[a] | 24 hours from time sampled | 24 hours from time sampled | 10 g | 50 mL | 8-oz. glass jar with Teflon-lined cap | 125-mL polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Total Organic Carbon (TOC)[a] | NA | 28 days from date sampled | 5 g | 10 mL | 8-oz. glass jar with Teflon-lined cap | 125-mL polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add $H_2SO_4$ until pH <2 and cool to 4°C (ice in cooler) |
| Total Organic Halides (TOX) | NA | 7 days from date sampled | 100 g | 200 mL | 8-oz. glass jar with Teflon-lined cap | 1-L amber glass bottle | Cool to 4°C (ice in cooler) | Add $H_2SO_4$ until pH <2 and cool to 4°C (ice in cooler) |

**Table 8-2 Standard Sampling Holding Times, Preservation Methods, and Volume Requirements**

| Protocol Parameter | Holding Time | | Minimum Volume Required | | Container Type | | Preservation | |
|---|---|---|---|---|---|---|---|---|
| | Soil | Water | Soil | Water | Soil | Water | Soil | Water |
| Total Recoverable Petroleum Hydrocarbons[e] | 28 days from date sampled | 28 days from date sampled | 50 g | 1 L | 8-oz. glass jar with Teflon-lined cap | 1-L amber glass bottle | Cool to 4°C (ice in cooler) | Add $H_2SO_4$ until pH <2 and cool to 4°C (ice in cooler) |
| **EPA-CLP** | | | | | | | | |
| VOA[e] | 10 days from date received | 10 days from date received | 15 g | One 40-mL vial; no air space | Two 40-mL vials; no air space | Two 40-mL vials; no air space | Cool to 4°C (ice in cooler) | Add HC1 until pH <2 and cool to 4°C (ice in cooler) |
| Semi-VOA (BNAs)[e] | 10 days to extract from date received | 5 days to extract from date received | 30 g | 1 L | 8-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| PCBs[d,e] | 10 days to extract from date received | 5 days to extract from date received | 30 g | 1 L | 4-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Pesticides/PCBs[d,e] | 10 days to extract from date received | 5 days to extract from date received | 30 g | 1 L | 8-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Metals[c] | 6 months from date sampled | 6 months from date sampled | 10 g | 300 mL | 8-oz. glass jar with Teflon-lined cap | 1-L polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add $HNO_3$ to pH <2 and cool to 4°C (ice in cooler) |
| Cyanide[c] | 12 days from date received | 12 days from date received | 10 g | 100 mL | 8-oz. glass jar with Teflon-lined cap | 1-L polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add NaOH to pH >12 and cool to 4°C (ice in cooler) |
| **NYSDEC-CLP** | | | | | | | | |
| VOA[e] | 7 days from date received | 10 days from date received | 15 g | One 40-mL vial; no air space | Two 40-mL vials; no air space | Two 40-mL vials; no air space | Cool to 4°C (ice in cooler) | Add HC1 until pH <2 and cool to 4°C (ice in cooler) |
| Semi-VOA (BNAs)[e] | 5 days to extract from date received | 5 days to extract from date received | 30 g | 1 L | 8-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |

## Table 8-2 Standard Sampling Holding Times, Preservation Methods, and Volume Requirements

| Protocol Parameter | Holding Time | | Minimum Volume Required | | Container Type | | Preservation | |
|---|---|---|---|---|---|---|---|---|
| | Soil | Water | Soil | Water | Soil | Water | Soil | Water |
| PCBs[d,e] | 5 days to extract from date received | 5 days to extract from date received | 30 g | 1 L | 4-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Pesticides/PCBs[d,e] | 5 days to extract from date received | 5 days to extract from date received | 30 g | 1 L | 8-oz. glass jar with Teflon-lined cap | ½-gallon amber glass bottle | Cool to 4°C (ice in cooler) | Cool to 4°C (ice in cooler) |
| Metals[c] | 6 months from date sampled | 6 months from date sampled | 10 g | 300 mL | 8-oz. glass jar with Teflon-lined cap | 1-L polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add $HNO_3$ to pH <2 and cool to 4°C (ice in cooler) |
| Cyanide[c] | 12 days from date received | 12 days from date received | 10 g | 100 mL | 8-oz. glass jar with Teflon-lined cap | 1-L polyethylene bottle with polyethylene-lined cap | Cool to 4°C (ice in cooler) | Add NaOH to pH >12 and cool to 4°C (ice in cooler) |
| **EPA Water and Waste** | | | | | | | | |
| Total Dissolved Solids (TDS) | NA | 7 days from date sampled | NA | 200 mL | NA | 1-L polyethylene bottle with polyethylene-lined cap | NA | Cool to 4°C (ice in cooler) |

Note: All sample bottles will be prepared in accordance with EPA bottle-washing procedures. These procedures are incorporated in E & E's Laboratory and Field Personnel Chain-of-Custody Documentation and Quality Assurance/Quality Control Procedures Manual, July 1987.

[a] Technical requirements for sample holding times have been established for water matrices only. However, they are also suggested for use as guidelines in evaluating soil data.
[b] Holding time for GC/MS analysis is 7 days if samples are not preserved.
[c] Maximum holding time for mercury is 28 days from time sampled.
[d] If one container has already been collected for PCB analysis, then only one additional container need be collected for extractable organic, BNA, or pesticides/PCB analysis.
[e] Extra containers required for MS/MSD.

Key:

NA = Not applicable.

### 8.4.5 Compositing Samples

Compositing is the process of physically combining and homogenizing several individual soil aliquots of the same volume or weight. Compositing samples provides an average concentration of contaminants over a certain number of sampling points. Compositing dilutes high-concentration aliquots; therefore, detection limits should be reduced accordingly. If the composite area is heterogeneous in concentration and its composite value is to be compared to a particular action level, then that action level must be divided by the total number of aliquots making up the composite for accurate determination of the detection limit.

### 8.4.6 Splitting Samples

Splitting samples (after preparation) is performed when multiple portions of the same samples are required to be analyzed separately. Fill the sample containers simultaneously with alternate spoonfuls of the homogenized sample (see Figure 8-7).

## 8.5 Post-Operations

### 8.5.1 Field

Decontaminate all equipment according to E & E's SOP for Sampling Equipment Decontamination (see ENV 3.15).

### 8.5.2 Office

Organize field notes into a report format and transfer logging information to appropriate forms.

# 9. Calculations

There are no specific calculations required for these procedures.

# 10. Quality Assurance/Quality Control

The objective of QA/QC is to identify and implement methodologies that limit the introduction of error into sampling and analytical procedures.

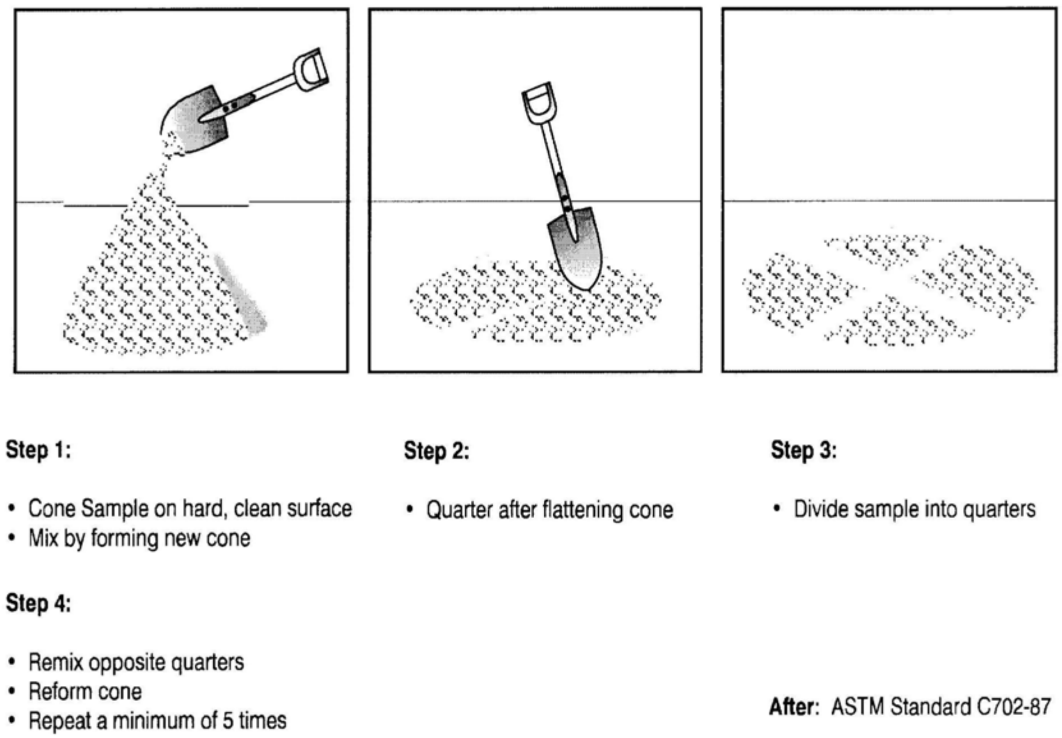



**Figure 8-7 Quartering to Homogenized and Split Samples**

## 10.1 Sampling Documentation

### 10.1.1 Soil Sample Label

All soil samples shall be documented in accordance with E & E's SOP for Sample Packaging and Shipping (see ENV 3.16). The soil sample label is filled out prior to collecting the sample and should contain the following:

1. Site name or identification.
2. Sample location and identifier.
3. Date samples were collected in a day, month, year format (e.g., 03 Jan 88 for January 3, 1988).
4. Time of sample collection, using 24-hour clock in the hours:minutes format.
5. Sample depth interval. Units used for depths should be in feet and tenths of feet.
6. Preservatives used, if any.
7. Analysis required.

8. Sampling personnel.

9. Comments and other relevant observations (e.g., color, odor, sample technique).

### 10.1.2 Logbook

A bound field notebook will be maintained by field personnel to record daily activities, including sample collection and tracking information. A separate entry will be made for each sample collected. These entries should include information from the sample label and a complete physical description of the soil sample, including texture, color (including notation of soil mottling), consistency, moisture content, cementation, and structure.

### 10.1.3 Chain of Custody

Use the chain-of-custody form to document the types and numbers of soil samples collected and logged. Refer to E & E's SOP for Sample Packaging and Shipping (see ENV 3.16) for directions on filling out this form.

## 10.2 Sampling Design

1. Sampling situations vary widely; thus, no universal sampling procedure can be recommended. However, a Sampling Plan should be implemented before any sampling operation is attempted, with attention paid to contaminant type and potential concentration variations.

2. Any of the sampling methods described here should allow a representative soil sample to be obtained, if the Sampling Plan is properly designed.

3. Consideration must also be given to the collection of a sample representative of all horizons present in the soil. Selection of the proper sampler will facilitate this procedure.

4. A stringent QA Project Plan should be outlined before any sampling operation is attempted. This should include, but not be limited to, properly cleaned samplers and sample containers, appropriate sample collection procedures, chain-of-custody procedures, and QA/QC samples.

# 11. Data Validation

The data generated will be reviewed according to the QA/QC considerations that are identified in Section 10.

## 11.1 Quality Assurance/Quality Control Samples

QA/QC samples are used to identify error due to sampling and/or analytical methodologies and chain-of-custody procedures.

### 11.1.1 Field Duplicates (Replicates)

Field duplicates are collected from one location and treated as separate samples throughout the sample handling and analytical processes. These samples are used to assess total error for critical samples with contaminant concentrations near the action level.

### 11.1.2 Collocated Samples

Collocated samples are generally collected 1.5 to 3.0 feet away from selected field samples to determine both local soil and contaminant variations on site. These samples are used to evaluate site variation within the immediate vicinity of sample collection.

### 11.1.3 Background Samples

Background or “clean” samples are collected from an area upgradient from the contamination area and representative of the typical conditions. These samples provide a standard for comparison of on-site contaminant concentration levels.

### 11.1.4 Rinsate (Equipment) Blanks

Rinsate blanks are collected by pouring analyte-free water (i.e., laboratory de-ionized water) on decontaminated sampling equipment to test for residual contamination. These samples are used to assess potential cross contamination due to improper decontamination procedures.

### 11.1.5 Performance Evaluation Samples

Performance evaluation samples are generally prepared by a third party, using a quantity of analyte(s) known to the preparer but unknown to the laboratory. The percentage of analyte(s) identified in the sample is used to evaluate laboratory procedural error.

### 11.1.6 Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

MS/MSD samples are spiked in the laboratory with a known quantity of analyte(s) to confirm percent recoveries. They are primarily used to check sample matrix interferences.

### 11.1.7 Field Blanks

Field blanks are prepared in the field with certified clean sand, soil, or water. These samples are used to evaluate contamination error associated with sampling methodology and laboratory procedures.

#### 11.1.8 Trip Blanks

Trip blanks are prepared prior to going into the field using certified clean sand, soil, or water. These samples are used to assess error associated with sampling methodology and analytical procedures for volatile organics.

# 12. Health and Safety

## 12.1 Hazards Associated with On-Site Contaminants

Depending on site-specific contaminants, various protective programs must be implemented prior to soil sampling. The site Health and Safety Plan should be reviewed with specific emphasis placed on a protection program planned for direct-contact tasks. Standard safe operating practices should be followed, including minimization of contact with potential contaminants in both the vapor phase and solid matrix by using both respirators and disposable clothing.

Use appropriate safe work practices for the type of contaminant expected (or determined from previous sampling efforts):

- Particulate or Metals Contaminants
  - Avoid skin contact with, and ingestion of, soils and dusts.
  - Use protective gloves.

- Volatile Organic Contaminants
  - Pre-survey the site with an HNu 101 or OVA 128 prior to collecting soil samples.
  - If monitoring results indicate organic constituents, sampling activities may be conducted in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing.

# 13. References

ASTM D 1586-67 (reapproved 1974), ASTM Committee on Standards, Philadelphia, PA.

ASTM D 1586-84, Penetration Test and Split Barrel Sampling of Soils.

Barth, D. S. and B. J. Mason, 1984, *Soil Sampling Quality Assurance User's Guide*, EPA-600/4-84-043.

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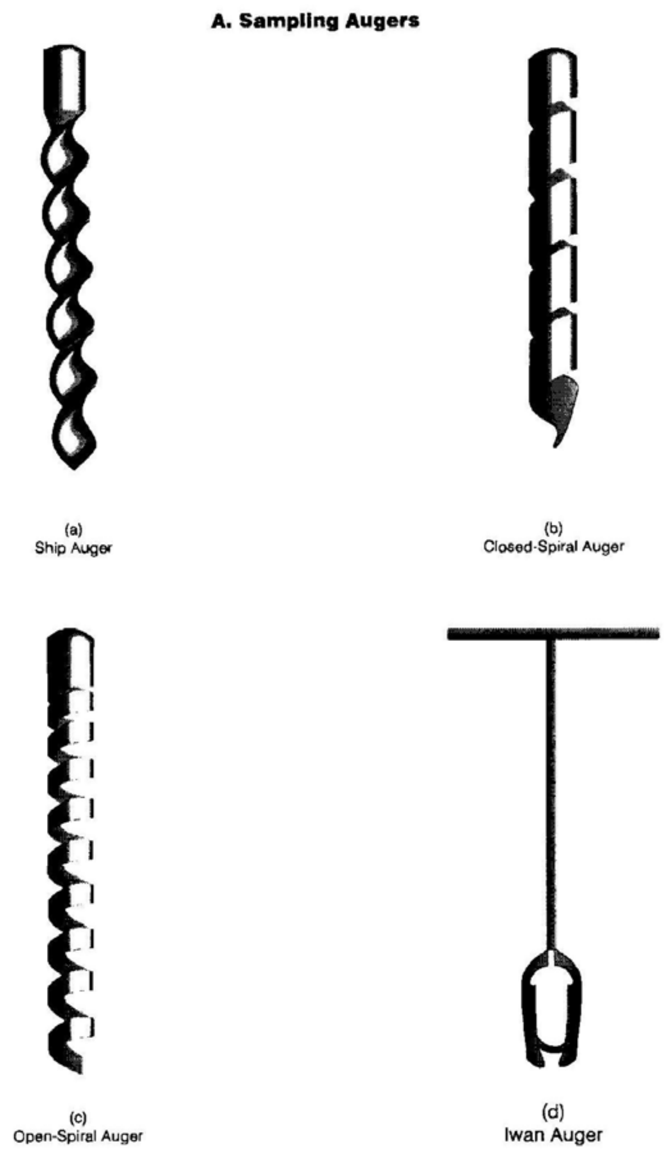
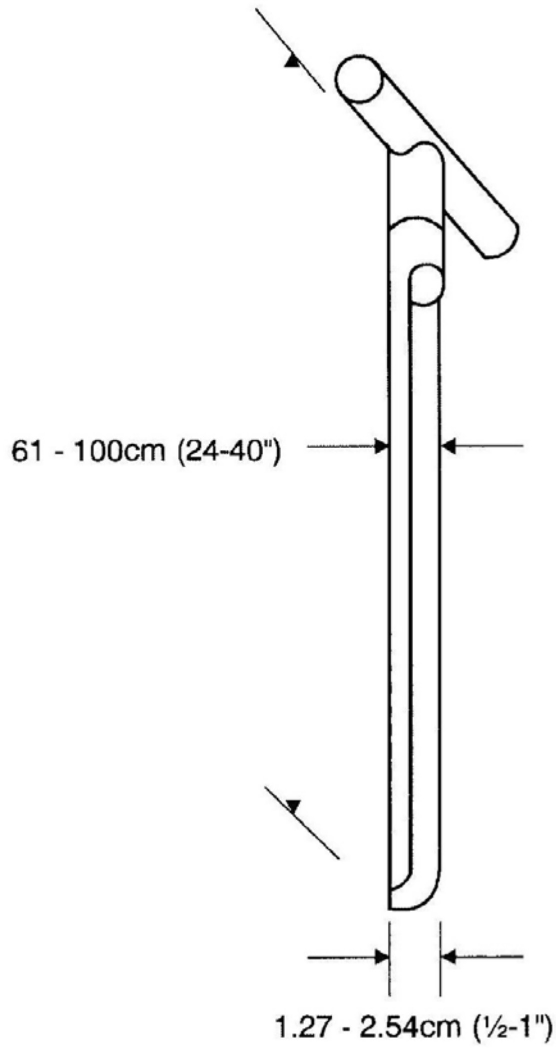
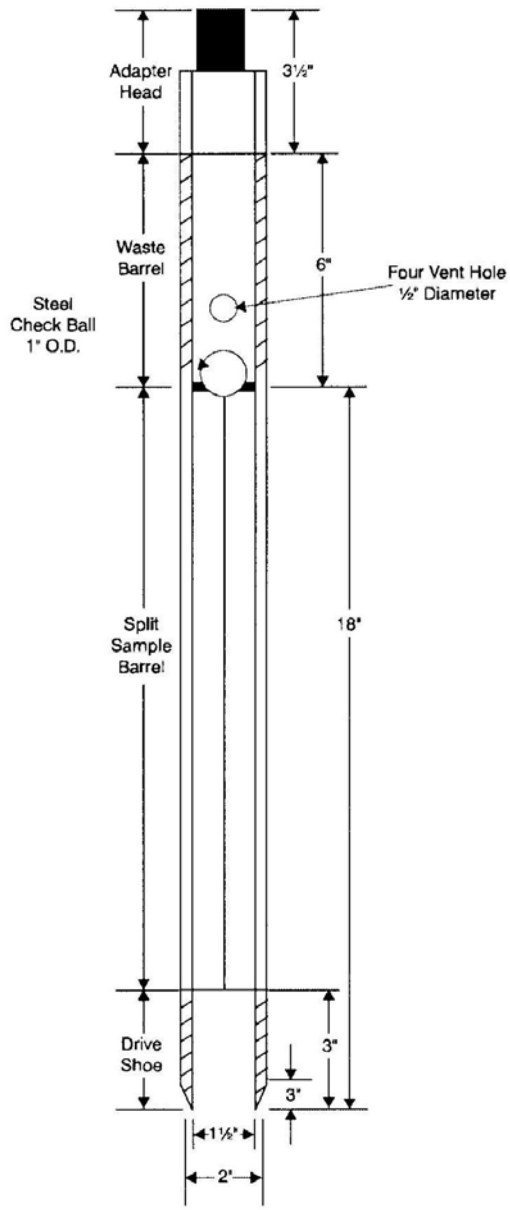
## A SAMPLING AUGERS



## B SAMPLING TRIER



## C SPLIT-SPOON SAMPLER



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STANDARD OPERATING PROCEDURE

# SAMPLING EQUIPMENT DECONTAMINATION



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# 1. Scope and Application

The purpose of this procedure is to provide a description of methods for preventing or reducing cross-contamination and general guidelines for designing and selecting decontamination procedures for use at potential hazardous waste sites. The decontamination procedures chosen will prevent introduction and cross-contamination of suspected contaminants in environmental samples, and will protect the health and safety of site personnel.

# 2. Method Summary

Removing or neutralizing contaminants that have accumulated on personnel and equipment ensures protection of personnel from permeating substances, reduces/eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample contamination.

Cross-contamination can be removed by physical decontamination procedures. The abrasive and non-abrasive methods include the use of brushes, high pressure water, air and wet blasting, and high pressure Freon cleaning. These methods should be followed by a wash/rinse process using appropriate cleaning solutions. A general protocol for cleaning with solutions is as follows:

1. Physical removal.
2. Non-phosphate detergent plus tap water.
3. Tap water.
4. 10% nitric acid.
5. Distilled/deionized water rinse.
6. Solvent rinse.
7. Total air dry.
8. Triple rinse with distilled/deionized water.

This procedure can be expanded to include additional or alternate solvent rinses that will remove specified target compounds if required by site-specific work plans (WP) or as directed by a particular client.

# 3. Interferences

The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte-free distilled/deionized water. Distilled water available from local grocery stores and pharmacies is generally not acceptable for final decontamination rinses. Contaminant-free deionized water is available from commercial vendors and may be shipped directly to the site or your hotel.

The use of an untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal water treatment system.

## 4. Equipment/Apparatus

The following are standard materials and equipment used as a part of the decontamination process:

- Appropriate protective clothing;
- Air purifying respirator (APR);
- Field log book;
- Non-phosphate detergent;
- Selected high purity, contaminant-free solvents;
- Long-handled brushes;
- Drop cloths (plastic sheeting);
- Trash containers;
- Paper towels;
- Galvanized tubs or equivalent (e.g., baby pools);
- Tap water;
- Contaminant-free distilled/deionized water;
- Metal/plastic container for storage and disposal of contaminated wash solutions;
- Pressurized sprayers, $H_2O$;
- Pressurized sprayers, solvents;
- Trash bags;
- Aluminum foil;
- Sample containers;

- Safety glasses or splash shield; and
- Emergency eyewash bottle.

# 5. Reagents

There are no reagents used in this procedure aside from decontamination solutions used for the equipment. The type of decontamination solution to be used shall depend upon the type and degree of contamination present and as specified in the project/site-specific Quality Assurance Project Plan (QAPP).

In general, the following solvents are utilized for decontamination purposes:

- 10% nitric acid wash ( reagent grade nitric acid diluted with deionized/distilled water – 1 part acid to 10 parts water)[a];
- Acetone (pesticide grade)[b] ;
- Hexane (pesticide grade)[b];
- Methanol; and
- Methylene chloride[b].

[a] Only if sample is to be analyzed for trace metals.
[b] Only if sample is to be analyzed for organics requiring specific or specialized decontamination procedures. These solvents must be kept away from samples in order to avoid contamination by decon solvents.

# 6. Procedures

Decontamination is the process of removing or neutralizing contaminants that have accumulated on both personnel and equipment. Specific procedures in each case are designed accordingly and may be identified in either the Health and Safety Plan (HSP), WP, QAPP, or all three.

As part of the HSP, a personnel decontamination plan should be developed and set up before any personnel or equipment enters the areas of potential contamination. Decontamination procedures for equipment will be specified in the WP and the associated QAPP. These plans should include:

- Number and layout of decontamination stations;
- Decontamination equipment needed (see Section 4);

- Appropriate decontamination methods;
- Procedures to prevent contamination of clean areas;
- Methods and procedures to minimize worker contact with contaminants during removal of protective clothing;
- Methods and procedures to prevent cross-contamination of samples and maintain sample integrity and sample custody; and
- Methods for disposal of contaminated clothing, equipment, and solutions.

Revisions to these plans may be necessary for health and safety when the types of protective clothing, site conditions, or on-site hazards are reassessed based on new information.

### Prevention of Contamination

Several procedures can be established to minimize contact with waste and the potential for contamination. For example:

- Employing work practices that minimize contact with hazardous substances (e.g., avoid areas of obvious contamination, avoid touching potentially hazardous substances);
- Use of remote sampling, handling, and container-opening techniques;
- Covering monitoring and sampling equipment with plastic or other protective material;
- Use of disposable outer garments and disposable sampling equipment with proper containment of these disposable items;
- Use of disposable towels to clean the outer surfaces of sample bottles before and after sample collection; and
- Encasing the source of contaminants with plastic sheeting or overpacks.

Proper procedures for dressing prior to entrance into contaminated areas will minimize the potential for contaminants to bypass the protective clothing. Generally, all fasteners (zippers, buttons, snaps, etc.) should be used, gloves and boots tucked under or over sleeves and pant legs, and all junctures taped (see the Health and Safety Plan for these procedures).

### Decontamination Methods

All personnel, samples, and equipment leaving the contaminated area of a site must be decontaminated to remove any chemicals or infectious organisms that may have adhered to them. Various decontamination methods will either physically remove, inactivate by chemical detoxification/disinfection/sterilization, or remove contaminants by both physical and chemical means.

In many cases, gross contamination can be removed by physical means. The physical decontamination techniques can be grouped into two categories: abrasive methods and non-abrasive methods.

## 6.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following reviews the available abrasive methods.

### Mechanical

Mechanical methods include using brushes with metal, nylon, or natural bristles. The amount and type of contaminants removed will vary with the hardness of bristles, length of time brushing, and degree of brush contact. Material may also be removed by using appropriate tools to scrape, pry, or otherwise remove adhered materials.

### Air Blasting

Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, and time of air blasting dictate cleaning efficiency. The method's disadvantages are its inability to control the exact amount of material removed and its large amount of waste generated.

### Wet Blasting

Wet blast cleaning involves the use of a suspended fine abrasive. The abrasive/water mixture is delivered by compressed air to the contaminated area. By using very fine abrasives, the amount of materials removed can be carefully controlled.

## 6.2 Non-abrasive Cleaning Methods

Non-abrasive cleaning methods work by either dissolution or by forcing the contaminant off a surface with pressure. In general, less of the equipment surface is removed using non-abrasive methods.

### High-Pressure Water

This method consists of a high-pressure pump, an operator controlled directional nozzle, and high-pressure hose. Operating pressure usually ranges from 340 to 680 psi, which relates to flow rates of 20 to 140 lpm.

### Steam Cleaning

This method uses water delivered at high pressure and high temperature in order to remove accumulated solids and/or oils.

### Ultra-High-Pressure Water

This system produces a water jet from 1,000 to 4,000 atm. This ultra-high-pressure spray can remove tightly-adhered surface films. The water velocity ranges from 500 m/sec. (1,000 atm) to 900 m/sec. (4,000 atm). Additives can be used to enhance the cleaning action, if approved by the QAPP for the project.

### High-Pressure Freon Cleaning

Freon cleaning is a very effective method for cleaning cloth, rubber, plastic, and external/internal metal surfaces. Freon 113 (trichlorotriflorethane) is dense, chemically stable, relatively non-toxic, and leaves no residue. The vapor is easily removed from the air by activated charcoal. A high pressure (1,000 atm) jet of liquid Freon 113 is directed onto the surface to be cleaned. The Freon can be collected in a sump, filtered, and reused.

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. One or more of the following methods utilize cleaning solutions.

### Dissolving

Removal of surface contaminants can be accomplished by chemically dissolving them, although the solvent must be compatible with the equipment and protective clothing. Organic solvents include alcohols, ethers, ketones, aromatics, straight-chain alkanes, and common petroleum products. Halogenated solvents are generally incompatible with protective clothing and are toxic. Table 1 provides a general guide to the solubility of contaminant categories in four types of solvents.

### Surfactants

Surfactants reduce adhesion forces between contaminants and the surface being cleaned and prevents reposition of the contaminants. Non-phosphate detergents dissolved in tap water is an acceptable surfactant solution.

### Rinsing

Contaminants are removed and rinsing through dilution, physical attraction, and solubilization.

### Disinfection/Sterilization

Disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization methods are impractical for large equipment and personal protective clothing.

## 6.3 Field Sampling Equipment Cleaning Procedures

The following steps for equipment cleaning should be followed for general field sampling activities.

1. Physical removal (abrasive or non-abrasive methods).
2. Scrub with non-phosphate detergent plus tap water.
3. Tap water rinse.
4. 10% nitric acid (required during sampling for inorganics only).
5. Distilled/deionized water rinse.
6. Solvent rinse (required during sampling for organics only).
7. Total air dry (required during sampling for organics only).
8. Triple rinse with distilled/deionized water.

Table 1 lists solvent rinses which may be required for elimination of particular chemicals. After each solvent rinse, the equipment should be air-dried and triple-rinsed with distilled/deionized water.

Solvent rinses are not necessarily required when organics are not a contaminant of concern. Similarly, an acid rinse is not necessarily required if analysis does not include inorganics.

NOTE: Reference the appropriate analytical procedure for specific decontamination solutions required for adequate removal of the contaminants of concern.

Sampling equipment that requires the use of plastic or teflon tubing should be disassembled, cleaned, and the tubing replaced with clean tubing, if necessary, before commencement of sampling or between sampling locations.

**Table 1 Decontamination Solvents**

| Solvent | Soluble Contaminants |
|---|---|
| Water | Low-chain compounds<br>Salts<br>Some organic acids and other polar compounds |
| Dilute Bases<br>For example:<br>■ detergent<br>■ soap | Acidic compounds<br>Phenol<br>Thiols<br>Some nitro and sulfonic compounds |
| Organic Solvents:<br>For example:<br>■ alcohols (methanol)<br>■ ethers<br>■ ketones<br>■ aromatics<br>■ straight-chain alkanes (e.g., hexane)<br>■ common petroleum products (e.g., fuel oil, kerosene) | Nonpolar compounds (e.g., some organic compounds) |

WARNING: Some organic solvents can permeate and/or degrade the protective clothing.

# 7. Quality Assurance/Quality Control

QA/QC samples are intended to provide information concerning possible cross-contamination during collection, handling, preparation, and packing of samples from field locations for subsequent review and interpretation. A field blank (rinsate blank) provides an additional check on possible sources of contamination from ambient air and from sampling instruments used to collect and transfer samples into sample containers.

A field blank (rinsate blank) consists of a sample of analyte-free water passed through/over a precleaned/decontaminated sampling device and placed in a clean area to attempt to simulate a worst-case condition regarding ambient air contributions to sample contamination.

Field blanks should be collected at a rate of one per day per sample matrix even if samples are not shipped that day. The field blanks should return to the lab with the trip blanks originally sent to the field and be packed with their associated matrix.

The field blank places a mechanism of control on equipment decontamination, sample handling, storage, and shipment procedures. It is also indicative of ambient conditions and/or equipment conditions that may affect the quality of the samples.

Holding times for field blanks analyzed by CLP methods begin when the blank is received in the laboratory (as documented on the chain of parameters and associated analytical methods).

Holding times for samples and blanks analyzed by SW-846 or the 600 and 500 series begins at the time of sample collection.

# 8. Health and Safety

Decontamination can pose hazards under certain circumstances even though performed to protect health and safety. Hazardous substances may be incompatible with decontamination methods (i.e., the method may react with contaminants to produce heat, explosion, or toxic products). Decontamination methods may be incompatible with clothing or equipment (e.g., some solvents can permeate and/or degrade protective clothing). Also, a direct health hazard to workers can be posed from chemical decontamination solutions that may be hazardous if inhaled or may be flammable.

The decontamination solutions must be determined to be compatible before use. Any method that permeates, degrades, or damages personal protective equipment should not be used. If decontamination methods do pose a direct health hazard, measures should be taken to protect personnel or modified to eliminate the hazard.

All site-specific safety procedures should be followed for the cleaning operation. At a minimum, the following precautions should be taken:

1. Safety glasses with splash shields or goggles, neoprene gloves, and laboratory apron should be worn.

2. All solvent rinsing operations should be conducted under a fume hood or in open air.

3. No eating, smoking, drinking, chewing, or any hand-to-mouth contact is permitted.

# 9. References

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, 1988.

A Compendium of Superfund Field Operations Methods, EPA 540/p-87/001.

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, USEPA Region IV, April 1, 1986.

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October 1985.

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| **Revised:** | August 2008 |

STANDARD OPERATING PROCEDURE

# SAMPLE PACKAGING



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# 1. Introduction

Liquid and solid environmental samples are routinely collected by E & E during field surveys, site investigations, and other site visits for laboratory analysis. Unless the samples have anesthetic, noxious, or other properties that could inhibit the ability of a flight crew member to perform his or her duty or are known to meet the established U.S. Department of Transportation criteria for hazardous material (i.e., explosive, corrosive, flammable, poisonous), they are not regulated as hazardous materials.

This Standard Operating Procedure (SOP) describes the packaging procedures to be used by E & E's staff to ensure the safe arrival of the samples at the laboratory for analyses. These procedures have been developed to reduce the risk of damage to the samples (i.e., breakage of the sample containers), promote the maintenance of sample temperature within the cooler, and prevent spillage of the sampled material should a container be broken.

In the event the sample material meets the established criteria of a DOT hazardous material, the reader is referred to E & E's Hazardous Materials/Dangerous Goods Shipping Guidance Manual (see H&S 5.5).

# 2. Scope

This SOP describes procedures for the packaging of environmental samples in:

- Coolers;
- Steel, aluminum and plastic drums; and
- 4GV fiberboard boxes.

The Hazardous Materials/Dangerous Goods Shipping Guidance Manual will complete the information needed for shipping samples by providing guidance on:

- Hazard determination for samples which meet the USDOT definition of a hazardous material;
- Shipping profiles for "standard" shipments;
- Shipping procedures for "non-standard" shipments;
- Marking of packages containing hazardous materials;
- Labeling of packages containing hazardous materials; and
- Preparation of shipping papers for hazardous materials shipment.

# 3. Sample Packaging Procedures

## 3.1 General

It is E & E's intent to package samples so securely that there is no chance of leakage during shipment. This is to prevent the loss of samples and the expenditure of funds for emergency responses to spills and the efforts necessary to re-obtain the sample.

Over the years, E & E has developed several "standard" package configurations for the shipping of environmental samples. These standard package configurations are described below.

Liquid samples are particularly vulnerable. Because transporters (carriers) do not know the difference between a package leaking distilled water and a package leaking a hazardous chemical, they will react to a spill in an emergency fashion, potentially causing enormous expense to E & E for the cleanup of the sample material. Therefore, liquids are to be packed in multiple layers of plastic bags and absorbent/cushioning material to preclude any possibility of leaks from a package. This section defines the standard packaging configurations for environmental samples.

## 3.2 Liquid Environmental Sample Packaging Procedures

Liquid environmental samples should be collected and preserved as outlined in the Standard Operating Procedures (SOP) for Surface Water Sampling (ENV 3.12), and Groundwater Well Sampling (ENV 3.7). ***Preserved water samples are not considered to meet the HM/DG definitions of Class 8 (Corrosive) due to the preservative and are therefore considered to be nonhazardous samples.*** Liquid environmental samples may be shipped using an 80-quart cooler or an outer package consisting of either a steel or aluminum drum. Because the steel and aluminum drums provide little insulating capability, they should not be used for samples that require icing.

### Packaging Liquid Environmental Samples Using the 80-Quart Cooler

- Label and seal all water sample bottles according to appropriate sampling SOPs;
- Secure the bottle caps using fiberglass tape; and
- Place each amber, poly, and volatile organic analysis (VOA) bottle in a sealable plastic bag. Mark the temperature blank VOA bag for identification.

If a foam block insert is used:

- Line the cooler with two plastic bags;
- Place a foam insert (with holes cut to receive the sample bottles) inside the plastic bag;

- Place the bottles in the holes in the foam block;
- Fill void spaces with bagged ice to the top of the cooler;
- Fold over the plastic bags lining the cooler and secure shut with tape;
- Place Chain-of-Custody (C-O-C) form in a sealable bag and tape it to the inside of the cooler lid; and
- Secure the cooler with strapping tape and custody seal. Cover the custody seals with clear tape.

If acceptable absorbent material is used:

- Place 1 inch of inert absorbent material in the bottom of the cooler;
- Line the cooler with two plastic bags;
- Place each sample bottle inside the inner bag;
- Fill the void spaces around the bottles with absorbent to about half the height of the large bottles;
- Fill the remainder of the void spaces with bagged ice to within 4 inches of the top of the cooler, making sure the VOAs are in direct contact with a bag of ice;
- Fold over the plastic bags lining the cooler and secure shut with tape;
- Fill the remaining space in the cooler with absorbent to the top of the cooler;
- Place C-O-C form in a sealable bag and tape it to the inside of the cooler lid; and
- Secure the cooler with strapping tape and custody seal. Cover the custody seals with clear tape.

Note: Acceptable absorbent materials must not react dangerously with the liquid and include vermiculite only if certified asbestos free.

### Alternate Packaging Using 1A2/1B2 Drum

- Place 3 inches of inert absorbent material in the bottom of the drum;
- Line the drum with two plastic bags;
- Place each sample bottle inside the inner bag;

- Fill the void spaces around the bottles with absorbent to the height of the larger bottles;
- Fold over the plastic bags lining the drum and secure shut with tape;
- Fill the remaining space in the drum with absorbent to the top of the drum;
- Place C-O-C form in a sealable bag and tape it to the inside of the drum lid; and
- Secure the drum with closing ring and apply custody seals. Cover the custody seals with clear tape.

## 3.3 Soil/Sediment Environmental Sample Packaging Procedures

Soil/sediment environmental samples should be collected as outlined in the SOP for Soil Sampling (ENV 3.13), and SOP for Sediment Sampling (ENV 3.8). Soil/sediment environmental samples may be shipped using an 80-quart cooler, a 4GV fiberboard combination package, or an outer package consisting of either a steel or aluminum drum. Because the steel and aluminum drums provide little insulating capability, they should not be used for samples that require icing.

### Packaging Soil/Sediment Environmental Samples

- Label and seal each sample container according to SOPs;
- Secure the bottle caps using fiberglass tape;
- Place each sample bottle inside a sealable plastic bag and place it in its original shipping box or in individual fiberboard boxes. Mark the temperature blank bag for identification; and
- Secure the original shipping box with strapping tape, place shipping box in a plastic bag, and secure the plastic bag with tape.

If an 80-quart cooler is used:

- Place bubble pack or similar material on the bottom and sides of an 80-quart cooler;
- Place the bagged shipping boxes in the cooler with a layer of bubble pack between each box;
- Fill the void spaces with "blue ice" or ice in baggies to the top of the cooler;
- Place C-O-C form in a sealable baggie and tape it to the inside of the cooler lid; and

- Secure the cooler with strapping tape and custody seal. Cover the seals with clear tape.

If a 1A2/1B2 drum is used:

- Place 3 inches of inert absorbent material in the bottom of the drum;
- Line the drum with two plastic garbage bags;
- Place the boxes inside the inner bag;
- Fill the space around the samples with absorbent;
- Fold over the plastic bags lining the drum and secure shut with tape;
- Fill the remaining space around the bags with absorbent to the top of the drum;
- Place C-O-C form in a sealable bag and tape it to the inside of the drum lid; and
- Secure the drum with the closing ring and apply custody seals. Cover the custody seals with clear tape.

Note: If a small number of samples are being shipped, it may be more practical to package them using the absorbent or foam block configurations used for shipping liquid samples.

## 4. Shipping Procedures

Environmental samples are to be shipped as nonhazardous cargo. Unless the samples have anesthetic, noxious, or other properties that could inhibit the ability of a flight crew member to perform his or her duty or are known to meet the established U.S. Department of Transportation criteria for a hazardous material (i.e., explosive, corrosive, flammable, poisonous), they are not regulated as hazardous materials. When preparing the containers (i.e., cooler, drum, or box) for shipment, E & E staff must remove all labels from the outside container. Labels indicating that the contents may be hazardous are misleading and are not appropriate. Markings indicating ownership of the container, destination, and chain of custody labels are acceptable and can be attached as required.

When completing the paperwork for shipment, the standard nonhazardous forms must be used. Do not use the hazardous materials/dangerous goods airbills, either in total or in part; these forms are coded and their use will invite unnecessary questions. This will only serve to confuse DHL or Federal Express' terminal personnel and will cause much frustration and the delay of sample shipment.

Environmental sample packages can be shipped overnight by both DHL and Federal Express. When choosing between the two, cost should be considered. It is normally much cheaper to ship DHL. In addition, DHL tends to have remote locations open later in the evenings than Federal Express, which may be helpful when trying to complete a full day's sampling effort and still make the flights on time. Although both companies offer pickup of samples at the site, it is advisable to call ahead and ensure that this service is offered beforehand. In almost all cases, both companies will deliver to the laboratory of your choice on Saturdays. When planning for sampling activities, check with the companies in advance to verify pick-up and delivery schedules.